SPACE SCIENCE BOARD
National Academy of Sciences
2101 Constitution Avenue
Washington 25, D. C.

MINUTES

MEETING ON COSPAR'S FUTURE PROGRAM

Tuesday, November 15, 1960, 9:00 A. M.

Room 716, 1145 Nineteenth Street, N.W.
Washington, D. C.

Attendance: Dr. R. W. Porter, Chairman
Dr. H. Odishaw
Dr. H. Friedman
Dr. W. W. Kellogg
Dr. J. Lederberg
Mr. R. C. Peavey
Dr. B. B. Rossi
Dr. J. A. Simpson
Dr. J. A. Van Allen
Dr. E. H. Vestine
Dr. H. Wexler
Mr. J. Orlen, Secretariat

The Chairman opened the meeting by explaining that the purpose of calling the group together was to have an informal discussion about activities which COSPAR might undertake to better stimulate and further the interests of space science through international cooperation. Suggestions had been received for the purpose of this discussion in response to SSB Memorandum 179, and copies of these suggestions were circulated to the group for review. These suggestions, along with the results of the discussion of this group, were to be the basis for the presentation to the Space Science Board at its next meeting. The ultimate objective was to develop some realistic but imaginative proposals for the Chairman to present to COSPAR at its next meeting in April 1961.

The discussion covered some topics which dealt with general arrangements for international cooperation as well as specific scientific programs. These are summarized below in separate sections.

I. General Topics

Discussions on the following general topics are summarized below: international meetings, an international space journal and the COSPAR Bulletin, an international school of space science, the use of continuous telemetry, international participation in US launched experiments, rocket experiments, and an annual series of COSPAR international research programs.

International Meetings

Three alternative approaches to the organization of international meetings to discuss space science research were considered: 1) more frequent informal meetings, 2) appending space science sessions to large meetings of the traditional scientific disciplines, and 3) geographic regional meetings. In addition the possibility of having COSPAR hold a major scientific meeting in place of the delayed UN meeting was discussed.

1. One of the basic objectives of international cooperation in space research will be served if such meetings are used to create conditions favorable to increased contacts between US and Soviet experimenters. Up to the present, COSPAR meetings have been scheduled on an annual basis and have been organized into fairly formal business and scientific sessions. Dr. Lederberg proposed that meetings take place more frequently than once a year, in smaller groups and in a less formal setting. The advantages of this approach include the possibility of frequent informal and personal contacts with Soviet experimenters. Soviet cooperation has been sought, for example, for obtaining recordings of telemetering signals from US satellites and obtaining their views on decontamination and sterilization of the spacecraft. Usually the Soviet scientists agree in principle but claim they have to refer the question back to authorities at home; often this is the end of their response. An increased number of small meetings would provide additional opportunities to make repeated inquiries in a relaxed manner that might produce useful responses to our efforts to seek cooperation. It would also increase opportunities for private conversation, which would allow US scientists to get some measure of the depth of interest of Soviet experimenters in various aspects of space research. There seemed to be general agreement among the group that there was merit to this approach.

2. Despite the general agreement on a need for a channel of communication that is flexible and informal, there was general concern about the proliferation of meetings as an unwarranted taxing of the time of the scientists who attend them. For example, there are meetings scheduled for the IAF, the UN, the ICSU Unions and their affiliates and some regional activities such as the Latin American symposium in Buenos Aires and the European cooperative group. It was also recognized that meetings organized primarily to discuss space research usually are attended by the same clique of scientists. Since most scientists do not devote themselves to space research exclusively but are only interested in space research as one means of advancing their particular scientific discipline, the interests of a wider group of scientists might be tapped if space topics were discussed at meetings held by groups concerned with the traditional scientific disciplines. As with publications, there are traditions in each scientific discipline which generally govern the meetings attended by the practitioners. Thus in order to insure the interests of the best scientific minds in space activities, it was suggested that COSPAR hold its meetings by appending sessions on specialized space activities to an appropriate international meeting of one of the traditional scientific disciplines. An example cited was the symposium on the July 1959 event held in the IUGG Assembly in Helsinki. Moreover, it was pointed out that the IGY ionospheric program was developed at sessions of URSI by an URSI-IGY group. Similarly, the cosmic ray program of the IGY was developed at evening sessions of people who attended the meetings of the IUPAP's Cosmic Ray Commission.

In general this type of arrangement was described as follows: COSPAR might sponsor special sessions at two discipline meetings each year which it considered most relevant to its current concerns. Broad gauge specific COSPAR meetings would not be held except at four- or five-year intervals. Meanwhile, a system of discipline rapporteurs might feed back material to COSPAR during these intervals. These rapporteurs, after reviewing the plans or programs referred to at these discipline meetings, could pose special problems for COSPAR to look into in pursuing space science research in these areas.

More specifically, attention was drawn to the forthcoming meeting of the IUPAP in Japan scheduled for September 1961 and the forthcoming session of the International Congress of Biochemistry scheduled in Moscow in August 1961. Since most of the appropriate people to discuss space work in cosmic rays and in biology would be present at these two sessions, it was proposed that exploratory proposals be made to the organizers of these two meetings concerning the possibility of appending to them sessions concerned with international cooperation in space research as related to each of these two disciplines. Dr. Rossi agreed to contact the organizers of the IUPAP meeting and Dr. Lederberg agreed to contact the organizers of the Biochemistry meeting. These exploratory contacts were to be made in the context of preparing for the possibility of a proposal by Dr. Porter at COSPAR that it take the initiative in sponsoring or organizing special space research sessions at these meetings.

3. As another possible solution to the proliferation in the number of meetings, it was proposed that COSPAR might organize interdisciplinary meetings by geographical regions rather than on a world-wide basis -- hold one first in Europe and then in Asia, Africa and Latin America. This would make attendance easier and less costly for the scientists of the regions, and only selected scientists from other regions need attend any one meeting.

There was no concensus concerning the future organization of meetings concerned with space research. As noted above, the possibility of holding COSPAR sessions at the IUPAP and Biochemistry was to be explored, and the results would be reviewed at a later date. It was also agreed, however, that there was room for at least one more meeting of the world-wide interdisciplinary type planned for next April.

4. The proposal that COSPAR hold a major conference to substitute for the science program of the delayed UN conference was discussed briefly. The administrative capacity of COSPAR to manage a major, world-wide conference was questioned, and it was pointed out that the COSPAR meeting would not have the government participation necessary to achieve the political objectives involved in the UN conference.

International Journal of Space Research

Dr. Lederberg proposed an international journal of space science research to be published under COSPAR auspices simultaneously in several languages including English and Russian. Such a journal would help reduce the excessive national flavor

of some present publications, and would provide space experimenters with an important single reference source for a literature that is now spread among the journals of different countries and of different scientific disciplines. Also, it might serve as a bridge of international understanding by including the works of authors from many countries, and articles written jointly by scientists from two or more countries. The purposes of COSPAR would also be served since the results of experiments involving synoptic measurements and observations could be published in one place.

Concern was expressed over adding to the present proliferation of the number of journals. It was also pointed out that an international journal would have to compete for articles with the present publications traditional to the older scientific disciplines.

To overcome this problem, it was suggested that the COSPAR journal might publish on a non-preclusive basis so that a given article could be published both in the international journal and a discipline journal. Alternatively it was suggested that the international journal could confine itself to publishing review articles and abstracts which would serve as a reference to the original sources.

It was agreed that the proposal for an international journal would be submitted to the Space Science Board for further consideration.

In a related discussion, Dr. Van Allen suggested the publication of an informal newsletter which would include reports on observations of geophysical events. Such observations come from a variety of places around the world and are made by many different techniques, and by observers in many different specialties. Thus the experimenter who is trying to uncover possible correlations between events would benefit from a single source of information. It was agreed that an attempt would be made to have the existing COSPAR Bulletin serve this purpose.

International Space Science School

Dr. Simpson had proposed the establishment of an international school on experimentation in space. Faculty would be drawn from top scientific and engineering talent in countries having experience in space investigation and would include independent scientific investigators and leading engineers throughout the United States who are currently or have recently participated in the US space program. Students would be drawn from countries that have top talent in the scientific disciplines but who are without the specific technical experience of designing and using their own space hardware for scientific experiments. The principal aim of the school would be to bring scientists in other countries to the point where they could take advantage of offers, like that of the US, to launch experiments designed by other countries.

In the ensuing discussion the question was raised as to the relationship of an international space science school to the present programs of research associateships, fellowships and other ad hoc arrangements for on-the-job training. There are a variety of such arrangements now operating on an informal basis. There was general agreement that if such a school is set up it ought not to replace on-the-job training and that a period of time spent in the proposed school might very well be a prelude to one of these other forms of training.

It was emphasized that trainees should come from countries making complementary preparations for embarking on space research projects appropriate to their present capacity. It was considered essential that the trained scientist, when he returns home, would find waiting for him there the level of financial and laboratory support he needs to carry on his own independent work. An additional advantage that can be expected from the school form of training was cited from the example of the atomic energy training program provided at the Argonne National Laboratory. Students assembled at the Argonne School from various countries and, in addition to obtaining the necessary technical training, they developed contacts among themselves which often continued after they returned to their respective countries. This led to a continuation of the cross breeding of ideas and at times to the development of cooperative projects between countries. Another point that was stressed is the fact that working laboratories usually are dominated by a particular point of view and that a school, obtaining its faculty from a variety of laboratories, would give the trainees the benefit of a wide variety of points of view.

It was emphasized that if a school were set up it ought to be located on the site of a working laboratory. (The example of the California Institute of Technology was cited because of the accessability of the Jet Propulsion Laboratory.) The curriculum of the school would vary and be tailored to the needs of particular individuals or particular classes from time to time but, in addition to courses on instrument design, the curriculum would include sufficient background on vehicles and engineering to allow the students to understand the nature, limitations and potentialities of payloads, trajectories, etc. It was also emphasized that the school should not limit itself to satellite experiments but should also include work on rocket experiments, tracking and telemetry, and possibly the organization and operation of moonwatch teams.

It was suggested that the desirability of emphasizing supporting research which can be done in laboratories on the ground should not be overlooked.

The prospect that the establishment of such a school in the United States, even though done under the auspices of COSPAR, might lead to the establishment of a similar school by the Soviet Union was not considered a drawback. The fact that it might lead to further opening of doors in the Soviet Union and additional information on their program was considered an advantage.

If this proposal is to be acted upon, it was assumed that the US, specifically NASA, would have to organize, finance and operate the school. Basically it would be a US national endeavor and could serve domestic as well as international needs for training. As with the similar AEC school program, this school might still bear the word international in its title and qualified faculty could be invited from other countries. If appropriate, COSPAR could be urged to recommend or endorse the desirability of the establishment of such a school. COSPAR might also assist in circularizing information on the school, its courses, qualifications of students, and might also assist in a first screening of applicants, etc.

The Committee agreed that no final recommendations on this proposal could be made at this time but that the Space Science Board should be asked to comment on this proposal.

Use of Continuous Telemetry to Encourage International Cooperation

In introducing his suggestions for two groups of satellite experiments, Dr. Friedman emphasized that they involved an important principle of operation which might have more general applicability; namely, the advantages of continuous telemetry. In support of this approach, Dr. Friedman cited the experience of his solar radiation experiment. This experiment uses continuous telemetry more as a result of the circumstances of its launching than by design, and the amount of data actually being recorded represents only about 2% of that available. However, this 2% is currently exhausting all of the manpower available in his research group for data reduction. Meanwhile, he has received a number of requests from scientists around the world for information that will enable them to receive and reduce data from the experiment, and Dr. Friedman believes that if such experiments are properly emphasized, many groups of solar radiation astronomers, geophysicists and astronomers will be happy to utilize them provided they can participate in them as equals. Each group could reduce its own data and these subsequently could be brought together through correspondence or a meeting -- the ultimate result would be more rapid digestion of the data and fuller utilization of the experiment. In addition to the assumed desirability of fostering international cooperation for its own sake, the advantages in terms of science of continuous telemetry were summarized as follows: Many types of scientific experiments rely on the obtaining of information for which a wide band width is required, and a better response can be obtained by reading out from continuous telemetry using wide band widths than by trying to compress the same information into small band widths for storage. The instrumentation package can be simplified, thus permitting more reliable instrumentation and the use of the available payload space and power for an increased number of sensors. As mentioned above, an increased number of people can be available for a quicker and more efficient reduction of data, and a more comprehensive picture of the phenomena being measured can be obtained. Another advantage mentioned arises from the problem confronting an experimenter in keeping in communication with various groups around the world who might have pertinent information on radio noise, storms, etc. A world-wide network of people utilizing experiments would create efficient contacts for obtaining such information and would also encourage a more comprehensive coverage of correlated ground observations.

In connection with the same discussion, Dr. Van Allen emphasized the advantages of the use of continuous telemetry in US launched experiments as opposed to the US offer to launch instrumented packages developed by scientists from other countries. Dr. Van Allen was not opposed to this offer but pointed out that the complexity of developing such instrumented packages and expressed the belief that it was quite unrealistic to expect a large-scale response to this offer. In contrast he cited the experience with his own experiment. The calibration code for Explorer I was published promptly, and the first scientific paper resulting from observations and telemetry resulting from Explorer I was from a Japanese scientist. Similarly the full code for Explorer VII was distributed, and though the response was not as great as hoped, there has been a substantial number of observation groups participating in the experiment including groups in Japan, Canada, the Netherlands, Sweden, Southern Rhodesia, Tasmania, the Congo (Belgian) and India. It was also pointed out that these observations can be made with very modest expenditures of funds. An observation station at Iowa City, which operates on a semi-automatic basis, has picked up over 4500 passes during the past 13 months at a cost in equipment of about $1,000.

Dr. Van Allen emphasized his view that for the near future the most significant and most promising approach to international cooperation is to encourage scientists in other countries to record and reduce data from experiments aboard US launched satellites. This can be done with modest outlays of money and in many cases improves the scientific value of the experiments and augments limited manpower for data reduction and analysis.

To provide the necessary basis for successful cooperation of this type, information on the experiments aboard US satellites would probably have to go out in advance of the launch or at least immediately thereafter and should include codes and calibrations. While such action may run contrary to past NASA policy, NASA should be requested to reconsider this policy. The objection that the proprietary interest of the prime experimenter must be protected was given sympathetic consideration, but it was pointed out the prime experimenter has immense practical advantage over other participants since his familiarity with the purpose of design and operations of the experiments cannot be matched. In general it was agreed that satellites in orbit should be considered an astronomical object available for observation and experimentation by anyone who is qualified.

In the ensuing discussion it was suggested that the Space Science Board should try to clarify elements which have served as obstacles to the participation of other scientists and should propose means by which information can be made available to COSPAR in a timely, meaningful and useful fashion and thereby passed on to experimenters in other countries. Greater effort on the part of COSPAR in informing other scientists of the possibility for cooperation in existing experiments would also be an important link in this chain. Dr. Rossi in particular agreed with this analysis in support of the view that there is a tremendous amount of scientific information that can be obtained from scientists of other countries who can observe US satellites. The problem is how to bring this directly to the attention of these experimenters in other countries. In his recent trip to Italy he had discussions on this subject and found there was a gap in their knowledge about the possibility for this kind of participation.

It was agreed that the increased use of continuous telemetry and appropriate arrangements for the participation of scientists from other countries was the single most important step for increasing international cooperation in the near future.

Experiments Conducted with Rockets

A number of suggested rocket experiment programs were discussed, and details on these are included in the appropriate part of Section II.

The world-wide coverage and synoptic measurements often required for research on the upper and lower atmosphere makes an increase in international cooperation desirable. Moreover, scientists in smaller countries can more readily participate in rocket experiments because of their relatively low cost and simpler instrumentation. There is evidence of great interest in this on the part of scientists from Sweden, Norway, Japan, Italy and West Germany.

Some items of instrumentation are becoming standardized and commercially available, and work on new instrumentation should be encouraged, particularly on the development of a beacon suitable for small rockets.

There is great interest on the part of US experimenters operating the meteorological rocket network to expand to a world-wide basis as soon as practical.

Because of the diversity of fields involved, the cooperation will have to be worked out jointly by a number of international groups including COSPAR, CIG and WMO. A symposium on the use of small rockets has been proposed as a joint venture with WMO and the IUGG for the April 1961 COSPAR meeting.

Meteorology

Dr. Wexler described current activities in the use of satellites for meteorology, particularly Tiros I and Tiros II, and indicated that a future satellite program for operational meteorological purposes would benefit from readout stations in a number of different locations throughout the world. Since the program would be operational this might be more of a problem within the jurisdiction of WMO than within COSPAR. This brought up the general problem of making an appropriate distinction between research activities proper to COSPAR and operational activities more suitable for WMO. The proposed session of the next COSPAR meeting to be jointly sponsored with WMO and the IUGG was cited as an example of this problem.

Explorer VII was also cited as an example of international collaboration in the field of meteorology particularly the earth's heat balance experiment of Dr. Suomi. Unknown to the US experimenters, the British have recorded tapes of several hundred passes of Explorer VII and have recently made inquiries on what to do with these tapes. A particular point of interest here is that there are some attempts at cooperation going on which are not fully known at this time. Another example of this type of activity is that British meteorologists also are planning to include some meteorological experiments in one of the joint US-British Scout launchings to measure Ozone distribution.

Dr. Porter suggested that this fitted into an idea which has been proposed earlier; namely, that COSPAR should develop an international program of space research activities to be accomplished in a given year and should request the cooperation of member countries. Through this device such bits and pieces of activities as were described could be coordinated into a comprehensive whole in which there was a central place for experimenters to find out what others are doing.

Dr. Wexler also alluded to the high cost of a meteorological satellite program and suggested that this held excellent possibilities for US-USSR cooperation. To date, however, the Russians have not evidenced sufficient interest to attend international meetings at which this subject was under discussion.

World Magnetic Survey

Dr. Vestine described the international plans for the World Magnetic Survey, and a discussion followed about the role which COSPAR could play in organizing the contribution to that program from rocket and satellite launchings. The Survey was approved by ICSU as an international program. The CIG and the IAGA (International Associations of Geomagnetism and Aeronomy of the IUGG) are planning the program. The IAGA Committee No. 5 on the WMS and Magnetic Charts has prepared technical recommendations which are included in Appendix A. The technical recommendations of the IAGA Committee will be submitted to the CIG with a request that arrangements be made with national committees for the collection of the required data. Current predictions are that the WMS should take place during an 18-month period sometime in 1964-1965. It is expected that this will be discussed at the CIG meeting in January, 1961, and it is anticipated that once started the WMS will continue as a program with re-adjustments in the Charts for 1975, etc.

The technical recommendations of the IAGA Committee No. 5 will provide a general description of the data required for the survey including a description of satellite and rocket data; however, it is considered that this Committee will not be competent to develop suitable rocket and satellite programs, and it is at this point that it was considered a suitable action for the CIG to request COSPAR to develop additional recommendations and invite the members of COSPAR to cooperate in obtaining the necessary measurements. It was generally agreed that synoptic measurements from satellites over a period of about one year would be desirable. Satellites for this purpose should have polar orbits at moderately low levels with highly eccentric orbits designed to break through the space outside the distorted magnetic fields in different locations. Continuous telemetry was recommended because the precision of data needed is high, and thus a truly international cooperative program is required in the reading out of telemetry. At least two satellites were recommended, both in polar orbits normal to each other, and the hope was expressed that the US and the USSR would each launch one of these satellites. Data obtained during the World Magnetic Survey is to be submitted by national committees to the World Data Centers for processing by an appropriate international body and the eventual development of a World Magnetic Chart.

It was agreed that appropriate initiative should be taken to recommend that the CIG request COSPAR's cooperation in this program and that simultaneously the US Space Science Board would be requested to consider recommendations on proposals that could be made to COSPAR for this purpose and on the contribution that the US could make to the eventual COSPAR program.

COSPAR Annual Space Research Programs

At the 10th meeting of Committee 4, a proposal that COSPAR develop a series of annual programs of collaborative space experiments received favorable consideration. The present group agreed that the suggested experiments discussed at this meeting could be fitted into such an annual series beginning with a very modest program for 1962.

It was agreed that this recommendation would be submitted to the Space Science Board.

II. Specific Proposals for Scientific Programs

The following proposals include written suggestions received in response to a request to the SPACE Science Board and Committee members as well as those presented orally during the meeting of Committee 4. They include in general experiments that will benefit from synoptic measurements at diverse locations, world-wide coverage (not necessarily simultaneous), especially satellite experiments that benefit from world-wide read-out of continuous telemetry. Not all of them have been fully considered by the Committee.

Tracking - Precise tracking of satellites especially photographic tracking leading to geodetic results - wide geographic dispersal of tracking installations and coordination of a plan of observations.

Geodesy - Geodetic satellite* with optical aids (flashing light, reflectors, etc.) and electronic aids (multi-frequency radio beacons, transponders) to facilitate precise tracking, to permit calibration of radio tracking methods and to study ionospheric refraction.

Completion of world-wide gravity survey and correlation with geodetic measurements from satellites.

Meteorology - Facilitate maximum cooperation in the use of satellites for meteorological research (e.g., cloud cover, infra-red radiation balance), including coordinated ground observations necessary to interpret satellite data.

Atmospheric Structure - Programs, especially synoptic measurements made with balloons and rockets, to investigate atmospheric density, pressure, temperature, composition, and degree of ionization as a function of time, location and altitude (e.g., ultraviolet absorption spectrum, falling sphere, mass spectrometer, sodium vapor, echoes from satellite wakes, geographic extension of meteorological rocket network.)

Ionosphere Parameters - Synoptic measurement of ionosphere parameters (e.g., electron density as a function of time and altitude, and geographic location; the motion of these concentrations - like electrojet; correlation of foregoing with solar activity in the form of particle streams and short wave radiations). These parameters can be measured directly by probes carried aloft by either rockets or satellites or indirectly by the propagation characteristics of radio waves emitted by multi-frequency beacons.

Synoptic ground-based ionospheric propagation exxperiments carried out simultaneously with foregoing probes and beacons.

*Should be eliminated unless approved by appropriate U.S. Government agencies.

Air Glow and Aurorae - Satellite and coordinated rocket program for world-wide horizontal and vertical mapping of airglow and aurorae in selected wavelength including changes in time, and correlation with solar activity.

Interactions of Particles with Atmosphere and Magnetic Field

Synoptic rocket probing of the aurorae to measure energy spectrum and composition of particle streams and x-rays produced by them.

World-wide synoptic observations of particle arrival, especially solar protons; energy spectrum of the particles as a function of geomagnetic latitude (especially forbidden protons).

Special attention should be paid to the foregoing during polar cap blackout.

A permanent high latitude launch site for rockets especially for measurements of aurorae, for probing polar ionosphere and for experiments requiring low geomagnetic cut-off.

A permanent equatorial launch site for rockets for the special study of phenomena peculiar to low latitudes.

Coordination of observations of particle arrival with magnetic field measurements in order to correlate them - e.g., by distributing satellites with magnetometers close to and far out from the earth to measure the progress of a sudden commencement and other magnetic storms; by clusters of satellites to measure localized magnetic effects.

World-wide synoptic measurement of cosmic rays.

Synoptic ground based measurements of the magnetic field carried out simultaneously with foregoing especially at conjugate points to assist in interpretation as in the proposed World Magnetic Survey.

Arrangements for contributing satellite and rocket geomagnetic measurements to the World Magnetic Survey.

Special note should be made of the great advantages in carrying out programs connecting ionosphere studies, particle arrival, magnetic storms, and solar activity during sunspot minimum when solar events do not overlap. Also should be coordinated with CIG program for World Magnetic Survey.

Geophysical satellite (as proposed by NASA) including measurements in ionospheric physics, trapped particles, electromagnetic radiation, magnetic fields and micrometeorities -- should emphasize international participation particularly in read-out of telemetry. Same is true for the orbiting solar observatory and the orbiting astronomical observatory.

Interplanetary Fields and Particles - Programs to measure particles and magnetic fields in interplanetary space and their relation to solar activity.

Especially the variations in these measurements during sunspot minimum in the plane of the ecliptic away from the sun, and perpendicular to the ecliptic.

Photometric observations of the solar aureole from balloons, rockets and satellites as a measure of scattering by interplanetary dust.

Possible effects of geomagnetic field on meteorite distribution - analogous to auroral zones.

Variations, if any, in dust and meteorite distribution with magnetic storms.

Solar Radiation - Continuous monitoring of solar radiation with a satellite at selected wavelengths (particularly x-rays in the 2-8 A region, Lyman Alpha, and extreme longwave radio noise, etc.)

Continuation and possible elaboration in coordination with CIG of 24 hour solar patrol to furnish alerts for programs related to solar activity including timely commands to satellites, and to provide data useful in interpreting satellite results.

Biology - Biological rhythms of man and animals as affected by sudden phase shifts - experiments on the ground involving laboratories widely separated in longitude.

APPENDIX A

IAGA Committee No. 5 on the WMS and Magnetic Charts prepared the following technical recommendations:

1. (a) That the epoch of the world magnetic survey by 1960-65 reduced to epoch 1965.0, with cognizance of later need for reduction to epoch 1975.0 for inclusion of later results.

   (b) That charts be compiled on a scale of 1:10,000,000 in order to be published at some suitable scale.

2. (a) That the USSR be urged to undertake surveys over the oceans with the "Zarya" for secular magnetic change.

   (b) That as a general aim survey stations on the ground be located about 200 km apart where feasible.

   (c) That aeromagnetic surveys over the oceans provide profiles spaced about 300-400 km apart.

3. That the general aim intends that the intervals of the isolines be 1^{o} in declination (D) with a coarser interval of 6^{o} near the poles, and at 500 gamma intervals in horizontal intensity (H), vertical intensity (Z), total intensity (F), north intensity (X), and east intensity (Y). For inclination (I), a contour interval of 2^{o} is suggested for equatorial regions, 1^{o} in middle and higher latitudes. The contour interval for anomalies where indicated should be about 500 gammas. The contour interval can be reduced in the case of detailed anomaly surveys if the scale of charting permits this reduction.

4. That a potential analysis be made providing spherical harmonic terms up to and including a degree and order useful for adequate representation of the data.

5. That the height of aeromagnetic surveys should be noted by observers.

6. That earth satellite measurements of the geomagnetic field or other suitable data of useful accuracy be used where feasible to supplement the values at and near the ground.

7. That the prompt provisions of observatory and other estimates of secular change be stressed and facilitated.