CENTRE NATIONAL DE RECHERCHES DE L'ESPACE

3, Avenue Circulaire, Uccle – Bruxelles 18

NOTES PRELIMINAIRES

No 7

(ANNEXE)

THE SPACE SCIENCE SYMPOSIUM ORGANISED BY THE COMMITTEE ON SPACE RESEARCH (COSPAR) NICE, JANUARY 11-15, 1960

par Marcel NICOLET

THE SPACE SCIENCE SYMPOSIUM
ORGANISED BY
THE COMMITTEE ON SPACE RESEARCH (COSPAR)
NICE, JANUARY 11-15, 1960.

INTRODUCTION

Dans la note préliminaire n° 7, j'ai rédigé à l'intention des membres du CNRE une analyse critique des travaux qui furent présentés au Symposium de Nice de janvier 1960. Dans cette rédaction, j'ai tenu compte des principaux travaux déjà publiés afin de dégager les résultats essentiels acquis dans le domaine des recherches scientifiques spatiales.

Cette annexe à la Note préliminaire n° 7 est la copie du rapport officiel (préliminaire) de la réunion du COSPAR et des rapports des comités nationaux faisant partie du COSPAR.

Vous remarquerez que les "règles" du COSPAR diffèrent des règles généralement adoptées pour les Unions et Comités scientifiques de l'ICSU. Ici on nomme deux Vice-Présidents qui doivent être respectivement américain et russe : Deux autres membres sont désignés par les américains et deux autres par les russes. De même, on trouve des présidents et membres de groupes de travail du COSPAR alors que leur pays ne fait pas partie du COSPAR.

Il faut également noter que la cotisation à COSPAR n'est pas encore définie officiellement.

Enfin, vous remarquerez que j'ai été très prudent en présentant le programme belge.

M. NICOLET.

COMMITTEE ON SPACE RESEARCH

ESTABLISHED BY
THE INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

R E P O R T

OF

THE THIRD COSPAR MEETING

Nice, France, January 8 - 16

1960

INDEX

Appendices

1. INTRODUCTION

The first meeting of the Committee on Space Research, under the terms of the new Charter, took place in Nice (France) in the Centre Universitaire Mediterranéen, on the 8th., 9th., 13th. and 16th. of January 1960. A complete list of delegates, advisors and observers who were present at one or more of the sessions is attached as Appendix A to this report.

The first plenary session opened with the Presidential address. The President welcomed all participants and expressed his appreciation of the generous hospitality COSPAR had received from the Government of France and the help COSPAR had experienced in the preparation of the Symposium. The President pointed out that the hundred papers presented at the Symposium reflected the rapid progress made in the many branches of space research. He mentioned the photographs taken of the reverse side of the moon as a particularly fine achievement. He informed the meeting that he had expressed admiration on behalf of COSPAR by a telegram to the U.S.S.R. Academy of Sciences, when the second Soviet space rocket had reached the moon.

The President stated that relations with the United Nations and its Specialised Agencies, UNESCO and ITU are excellent; as are the relations with COSPAR's parent body ICSU and its organisms; e.g. the CIG.

The problem of the COSPAR Charter has been solved and the new Charter has been formally accepted. The main puzzle had been the weighting of the influence of the National Scientific Institutions and the influence of the International Scientific Unions. The President stated that he expected more nations would join COSPAR in 1960. Further, he pointed out that, in spite of the provisional status during 1959, definite work had already been done: for example, in preparing a considered statement from COSPAR for the ITU Conference on the immediate need of frequency allocations for space research; and in the organisation of an international rocket week. An important piece of work had been done by the Chairman of Working Group 3 on Data and Publications, who made a trip to the U.S.A. and the U.S.S.R. and gathered information about data exchange, which laid the foundations for efficient arrangements in the future. Finally, Professor van de Hulst referred to the death of Mr. Bik, the past Administrative Secretary of COSPAR, and of Professor Balth van der Pol, both of whom had rendered great services to COSPAR.

Plenary sessions were held on January 8th. from 9.30 - 11am., and from 4 - 6pm.; January 9th. from 9.30 - 11am., and from 11.40am. - 12.30pm.; January 13th. from 8.30 - 11pm.; January 16th. from 9am. - 12.40pm.

.../2

(1. continued)

The Executive Council met on January 9th., from 11-11.14am., and from 2 - 2.45pm.

Much of the remaining time between the sessions of the full COSPAR and of the Executive Council was taken by meetings of the Working Groups and attendance at the Symposium. The reports of these Working Groups were discussed in the COSPAR sessions and these reports are attached as Appendices B, C and D.

The Vice-President, Dr. R.W. Porter, who had taken the Chair during the final session because of the illness of the President, formulated the following vote of thanks:

The Committee on Space Research

Expressed its appreciation of the gracious hospitality and generous courtesies extended to the Delegates and the Symposium participants by the City of Nice and its distinguished Mayor;

Is deeply indebted also to the Centre Universitaire Mediterranéen in Nice for granting to COSPAR the use of its Hall and beautiful Assembly Room;

Expresses its gratitude to the French Reception Commitee, consisting of Professor Pierre Auger, Professor Maurice Roy and Professor Charles Fehrenbach, for its help with preparations for the Symposium;

Is indebted, for the successful organization of the Symposium and its smooth course, to the Programme Committee: Academician A.A. Blagonravov, Professor T. Hatanaka, Dr. A. Moore, Dr. P. Muller and Mr. R.C. Peavey, and especially to Dr. H.K. Kallmann, the Scientific Secretary;

Appreciates the support of this Meeting and Symposium which was provided with unflagging diligence and very welcome good humour under a heavy burden by the members of the COSPAR Secretariat;

Extends its deepest appreciation to the Observatoire de Haute Provence, which graciously invited many delegates and participants, and made possible a most interesting and valuable inspection of its fine new astronomical equipment.

....../3

2. ELECTION OF OFFICERS

The elections of officers during the January 9th., session proceeded as follows. COSPAR took notice of the fact that the U.S.A. and U.S.S.R. Academies of Sciences had each made one nomination for Vice-President and the President welcomed Dr. R.W. Porter and Professor A.A. Blagonravov as COSPAR's new Vice-Presidents.

Dr. Porter then submitted a slate of five nominees for two further elected members of the Executive Council, namely:

Professor L.G.H. Huxley	representing	Australian Academy of Sciences.
Professor K. Kaneshige	representing	Science Council of Japan.
Professor H.S.W. Massey	representing	The Royal Society, U.K.
Dr. D.C. Rose	representing	National Research Council, Canada.
Professor M. Roy	representing	International Union of Theoretical and Applied Mechanics. (IUTAM)

In the subsequent election Professor H.S.W. Massey and Professor M. Roy were elected.

Professor Blagonravov then submitted a slate of two nominees for two further elected members of the Executive Council, namely:

Professor E. Buchar	representing	Czechoslovakian Academy of Sciences.
Professor W. Zonn	representing	Polish Academy of Sciences.

The President pointed out a formal objection that the aforesaid Academies had not yet applied for membership, whereas the officers had to be chosen from among the COSPAR members. Professor Blagonravov then told the meeting that he had been informed that these Academies were intending to join COSPAR. Dr. Porter then suggested that the rule that officers have to be elected from COSPAR members be temporarily suspended for this particular case. This was unanimously decided and Professor W, Zonn and Professor E. Buchar were consequently elected as members of the Executive Council.

The Executive Council then held a brief meeting in which it nominated Professor H.C. van de Hulst representing the International Astronomical Union (IAU) as President. When the plenary COSPAR meeting reconvened, it unanimously supported this nomination. Professor van de Hulst accepted this nomination and, referring to the rule that every officer has a term of three years, asked permission to consider his term of office to have started on Nomember 15th., 1958. Dr. Porter said that he was not in favour of this but the President stated that he should, nevertheless, like to have this statement recorded as a condition for his acceptance.

.../4

3. MEMBERSHIP

The question of the membership of national institutions was taken up during the session on January 16th. The President pointed out that every National Scientific Institution which wishes to be represented in COSPAR has to meet three requirements. The relevant institution should :

A. Adhere to ICSU.
B. Express the wish to obtain membership in COSPAR.
C. Be actively engaged in space research.

The meeting decided that it is for COSPAR to judge whether a country is actively engaged in space research. It was further decided that the letter from the relevant National Institution, expressing the wish to become represented in COSPAR, would be circulated to the members of COSPAR and, if within three months no objections are received, then the relevant National Institution will have obtained membership. If objections are raised, then the application will be referred for decision to the next full COSPAR meeting.

Several delegates inquired about the possibilities of appeal on a decision about COSPAR membership for a National Scientific Institution. The President pointed out that COSPAR, as a Special Committee of ICSU, is responsible for all its actions to ICSU and that any member of ICSU can take steps to have a discussion on COSPAR procedures placed on the Agenda of the ICSU General Assembly, so that, in his opinion, it was not necessary for COSPAR to decide upon a special form of appeal.

The President briefly reviewed the state of the applications that had come in and proposed that solely during the session on the 16th., January 1960, the following countries, whose delegates were present at the session, would be considered to be voting members: Argentina, Australia, Belgium, Canada, Federal German Republic, France, India, Japan, Poland, South Africa, U.S.S.R., U.K. and U.S.A.

---

4. LIAISON WITH THE UNITED NATIONS ORGANISATION, ITS SPECIALIZED AGENCIES AND OTHER INTERNATIONAL BODIES.

United Nations

Immediately after its first meeting in November 1958, COSPAR had offered its services to the United Nations. Professor van de Hulst reported that when the United Nations *Ad Hoc* Committee on the Peaceful Uses of Outer Space first met in June 1959, he had received and accepted invitations for consultation both from the Secretary-General of the United Nations and from the Department of Natural Sciences of UNESCO.

.../5

(4. continued)

The President remarked that the relations are very good and COSPAR can be grateful that the special tasks which can be carried out by the non-governmental organizations federated in ICSU have been clearly put forth in the report of the Ad Hoc Committee.

The U.N. General Assembly, in December 1959, established a permanent Committee on the Peaceful Uses of Outer Space and decided to convene, in 1960 or 1961 under the auspices of the United Nations, an international conference for the exchange of experience in the peaceful uses of outer space.

The President moved a resolution repeating COSPAR's offer of its services. (See Resolution 1.) This was unanimously accepted.

UNESCO

The President pointed out that ICSU, as a non-governmental body, has a formal agreement with UNESCO.

He recalled with pleasure the consultations he had had on several occasions with Professor V. Kovda, the Director of UNESCO's Department of Natural Sciences, and welcomed Dr. H. Roderick, the Deputy-Director of that Department, as the UNESCO Observer.

Dr. Roderick thanked the President for the invitation and made the following statement:

> "The purpose of my remarks is to inform COSPAR of the UNESCO point of view in the hope that this information can possibly be of some use to the members of COSPAR.
>
> The General Conference of UNESCO (which is UNESCO's governing body) has passed a resolution that, in the field of space research, UNESCO should -
>
> stimulate research in this field
>
> and
>
> promote international or regional measures for the development of research in this field.
>
> In the light of this resolution, we wish strongly to support COSPAR in every possible way, as a competent, non-governmental, professional organization, to carry out international development in this field. What is UNESCO's role beyond this? As an intergovernmental organization, we wish to carry out only those requests in space research development (i) that can not be done by COSPAR and which are needed to stimulate research or (ii) require intergovernmental agreement.

(4. continued)

(Dr. Roderick's statement continued)

As possible examples, re (i) we propose to prepare a small multilingual dictionary of space terms, and re (ii) we will consider doing what we can:

a) to aid the sale from nation to nation of commercial small rockets for research;

b) to aid the organization of regional research groups (like CERN) if the interest arises among nations;

c) to aid the U.N. organize its space conference.

These are the rudiments of a possible plan. What plan UNESCO will actually follow depends on the needs of space research and also on the bringing to UNESCO's attention by the space scientists of these needs."

The President thanked Dr. Roderick for his words and added that UNESCO had already helped COSPAR in several other respects. The French UNESCO office had made the arrangements for duty-free importation of the instruments on exhibition at the Symposium. Moreover, the report of COSPAR's Working Group 3 mentioned that the UNESCO coupon scheme might form a solution to the problem encountered by some nations in paying for the data and publications they need for their research.

I.T.U. (International Telecommunications Union)

The President welcomed Dr. J.H. Gayer, the Observer on behalf of the ITU, and Dr. J. van der Mark, representing the C.C.I.R. (International Radio Consultative Committee). Official contact with ITU had been taken up just prior to the Ordinary Administrative Conference of the ITU in Geneva and COSPAR had been admitted as an Observer to this Conference. The President stated that he was pleased that the COSPAR statement and the further explanations by the COSPAR observers had received full attention at the Conference and that a number of frequency bands had been allocated to space research. The detailed results of the Conference had already been reported to Working Group 1.

Dr. Gayer, on behalf of the ITU, expressed his appreciation for having been invited to participate in the First International Space Science Symposium and the meetings of COSPAR. He said that ITU welcomes every opportunity to cooperate in areas of mutual interest. The Union greatly appreciated the cooperation extended by COSPAR through its President, Professor van de Hulst, at the Administrative Radio Conference held in Geneva from August 17th., to December 31st., 1959. Dr. Gayer remarked that since a detailed discussion on the Radio Allocations for space research, allotted by the Radio Conference, would be held in a

.../7

(4. contineed)

(Dr. Gayer's statement continued)

meeting of Working Group 1, he would only call attention to the fact that future studies would be undertaken by the ITU in the field of Radio Emissions from Artificial Satellites and other Space Vehicles, and that it was planned that an Extraordinary Administrative Radio Conference would be convened to deal with the problem of frequency bands for space radiocommunication purposes.

Dr. Gayer said that COSPAR's contributions to these studies would, as in the past, help to ensure fruitful results.

Dr. van der Mark, speaking on behalf of CCIR, explained that CCIR acts as a consultative committee to the ITU in radio matters and that among its new tasks is the study of the problems of the methods for cessation of radio signals from satellites which are no longer needed. The President said that COSPAR would certainly wish to cooperate in such studies since this was a problem that had already been discussed in Working Group 1. He asked whether CCIR would be able to refer certain questions for study to COSPAR in the same manner as its standing practice was to refer certain questions for study to URSI. Dr. van der Mark replied that he believed that it would certainly be possible to refer certain questions to URSI and COSPAR.

C.I.G. (Comité International de Géophysique)

The Secretary-General, Laclavère, spoke briefly during the last session on behalf of CIG. He expressed the wish for close cooperation between COSPAR and CIG. He reported that the projected World Magnetic Survey was to be carried out in the years 1962 - 1963 as a continuation of the IGY programme. He briefly explained that the most favourable period to implement the project was one of quiet Sun. Satellites will be used to measure the magnetic field components above the Earth, and observations of the conditions prevailing in the very high atmosphere were contemplated in order to establish correlations between solar activity and the magnetic conditions around the Earth. He expressed the wish that COSPAR should show an interest in this project.

5. REPORTS ON NATIONAL ACTIVITIES

The reports on national activities presented by the delegates of Argentina, Australia, Belgium, Canada, France, German Federal Republic, Japan, Netherlands, South Africa, U.S.S.R., U.K., U.S.A. during the several sessions, cover many pages. For practical reasons it has been decided to reproduce them in a separate document, which will be distributed together with this report.

.../8

6. ACTION ON WORKING GROUPS

The Executive Council in its session on January 9th., reviewed the situation in the Working Groups and took the following action, which was confirmed without change by the full COSPAR.

Working Group 1 - on Tracking and Telemetering :

The President recalled that Professor V.A. Ambartsumian had, as was decided by the COSPAR meeting of March 1959, been invited to become Chairman of this Working Group, but that no answer had yet been received. Professor Lovell had been found willing to act as interim chairman and to preside over the sessions of this Working Group during the Nice Meeting.

Professor Blagonravov stated that it was his understanding that Professor Ambartsumian is willing to serve as Chairman but that he was unable to come to Nice owing to other engagements. It was decided that the President should reconfirm the invitation to Professor Ambartsumian and that Professor Lovell would act as interim chairman until the invitation be accepted.

Note: The acceptance by Professor Ambartsumian has since been received.

The following members of Working Group 1 were appointed by the Executive Council :

Professor V.A. Ambartsumian	U.S.S.R.	Chairman
Professor W. Dieminger	W. Germany	
Dr. L. Goldberg	U.S.A.	
Professor L.G.H. Huxley	Australia	
Dr. R. Jastrow	U.S.A.	
Professor B.A. Kanzansky	U.S.S.R.	
Professor A.C.B. Lovell	U.K.	
Professor A. Masevitch	U.S.S.R.	
Professor A.P. Mitra	India	
Dr. P. Muller	France	
Professor G. Ogorodnikov	U.S.S.R.	
Professor N.V. Pushkov	U.S.S.R.	
Mr. M.O. Robins	U.K.	
Mr. F. Smith	U.S.A.	
Professor O.G. Villard	U.S.A.	

Working Group 2 - on Scientific Experiments :

Professor J. Bartels, Chairman of this Working Group, reported that, judging from experience gained during the meeting of the Working Group which had taken place the day before, it would not yet be wise to separate the biological and non-biological part of this Working Group.

..../9

(6. continued)

The following members of Working Group 2 were appointed by the Executive Council :

Professor J. Bartels	W. Germany	Chairman
Dr. H.E. Newell	U.S.A.	Reporter
Dr. P. Alexander	U.K.	
Professor W.J.G. Beynon	U.K.	
Dr. J. Blamont	France	
Dr. R.L.F. Boyd	U.K.	
Dr. J. Chapman	Canada	
Professor W.O. Fenn	U.S.A.	
Professor M. Florkin	Belgium	
Dr. H. Friedman	U.S.A.	
Professor F. Hoyle	U.K.	
Professor J. Kaplan	U.S.A.	
Professor V.V. Krasovsky	U.S.S.R.	
Professor L.W. Kurnosova	U.S.S.R.	
Dr. K. Maeda	Japan	
Professor M. Nicolet	Belgium	
Professor S.M. Poloskov	U.S.S.R.	
Dr. D.C. Rose	Canada	
Professor G.V. Schvitkovsky	U.S.S.R.	
Professor S.N. Vernov	U.S.S.R.	
Dr. H. Wexler	U.S.A.	

A Soviet scientist in the field of biological sciences is still to be nominated.

<u>Working Group 3 - on Data and Publications</u> :

The President announced that Professor A.P. Mitra had accepted the Chairmanship of this Working Group and has started his work by oral consultations with scientists in the U.S.A. and the U.S.S.R. He added that a detailed report on Professor Mitra's findings was now before the Working Group.

The following members of the Working Group were appointed by the Executive Council :

Professor A.P. Mitra	India	Chairman
Professor E. Miescher	Switzerland	
Dr. T. Nazarova	U.S.S.R.	
Dr. H. Odishaw	U.S.A.	
Dr. B.G. Pressey	U.K.	
Dr. J. Rösch	France	

..../10

7. FINANCES

The Executive Council, in its meeting on January 9th., appointed the following members of the Finance Committee:

Professor L.G.H. Huxley - Delegate for Australia
Dr. D.C. Rose - Delegate for Canada

It was decided to make these appointments for the term of one year and to review the composition of the Finance Committee when more National Scientific Institutions would have joined COSPAR. According to the rules for Special Committees of ICSU the Treasurer of ICSU is a member of the Finance Committee 'ex officio'. COSPAR approved the composition of the Finance Committee in its session of January 16th,

A report including a draft budget for 1960 for COSPAR was drawn up by the Finance Committee and Mr. MacLennan, the ICSU Accountant substituting for the Treasurer of ICSU. During the full COSPAR session of January 16th., Dr. Rose presented this report (Appendix E) and said that the Finance Committee recommended that the budget be adopted.

A discussion followed in which the following points were brought forward.

Professor Blagonravov said that an account of the income and expenditure for 1959 was necessary for a proper judgement of the budget and asked that such an account be made available as soon as possible. He expressed the desire of his Academy that the expenditure of COSPAR be reduced by dropping the policy, followed in 1959, that travel expenses and subsistence allowances of all delegates to a meeting of COSPAR or its governing body were paid from COSPAR funds. He added that the Academy of Sciences of the USSR already contributes to a hundred International Organizations and that the suggested amount of $15,000. would far exceed the present maximum contribution paid to any of the InternationalOrganizations. The Academy's funds could be more easily used directly for necessary travel. Professor Blagonravov stated that, for instance, the U.S.S.R. Academy is willing to send a Soviet scientist to assist the COSPAR Secretariat with translating the abstracts of the Symposium into Russian.

Dr. Porter expressed the opinion that some National Academies and most International Unions would find it very hard to secure sufficient travel funds, and would thus be forced to abstain from attending some or all COSPAR meetings. He said that the Academy of Sciences of the U.S.A. is opposed to this basic change in policy, but agrees to look again at the budget and at a possible reduction of the total amount of expenditure.

.../11

(7. continued)

Professor van de Hulst welcomed the offer of the U.S.S.R. Academy to send a Russian scientist to help the Secretariat with the preparations for the publication of the Symposium proceedings. With regard to the subject of travel expenses, he feared that Unions and faraway countries might have trouble in finding funds for their delegates. If COSPAR should decide that the estimated contributions are too high, the only correct way to reduce expenditure might be to reduce the number of meetings. He estimated that the Soviet proposal with respect to the normal meetings of COSPAR and its Working Groups would result in a 20 per cent reduction of the total expenditure but that he was not in favour of this proposal. He added that delegates, as sent by COSPAR e.g. to the I.T.U. Conference, should certainly be reimbursed by COSPAR since a situation might arise in which their instructions from COSPAR differed from the point of view taken by their national delegation.

Professor Bartels as Chairman of Working Group 2 said that he also saw the possibility of a substantial saving by conducting most of the work in the working groups by correspondence.

Mr. Laclavère, when asked for his opinion said that in the Unions and the ICSU the policy is not to reimburse the expenses of National Delegates. He recognised the importance of having full national representation at the meetings and that some countries may well be prevented from being represented from lack of funds. He said that if COSPAR adopted such a policy it might set a precedent for other Committees. Laclavère suggested that such an important matter should be referred to ICSU.

The discussion resulted in a general feeling that the time for preparation had been insufficient and that it was not possible to make an immediate decision but that the proposed budget should be reduced by about 20 per cent, although opinions varied on the manner in which this reduction should be made. The decisions finally unanimously taken are -

1. The Report of the Finance Committee is accepted for information.

2. In accordance with point II 4 of the Charter the matter of the budget for 1960 is referred to the Executive Council.

3. The ICSU Accountant is requested to prepare a statement of COSPAR income and expenditure over 1959.*

* Following decision 3, the statement is attached as Appendix F to this report.

8. COSPAR RESOLUTIONS

Each of the Working Groups presented in its report to the full COSPAR meeting a number of recommendations or resolutions for consideration by the full COSPAR. A Drafting Committee consisting of the Chairmen of the Working Groups and Professor Beynon who acted as Chairman of the Drafting Committee, was appointed during the session on January 13th., to put these in a form of draft resolutions to be discussed and voted upon by the full COSPAR. The Chairman of the Drafting Committee presented the result of this committee's work in the final session on January 16th. A number of further amendments were made. Also a number of resolutions not originating from one of the Working Groups were introduced in this session.

The finally adopted texts of all these resolutions are given below. In order to avoid confusion the original texts have been omitted from the reports of the Working Groups given in appendices B, C and D.

RESOLUTION 1 WAS PROPOSED BY THE PRESIDENT
IN THE FIRST PLENARY SESSION

1. Offer of Services to U.N.

The Committee on Space Research (COSPAR) established by the International Council of Scientific Unions,

Noting with great satisfaction the resolutions passed by the General Assembly of the United Nations Organization to form a committee on the peaceful uses of outer space and to convene an international scientific conference for the exchange of experience in the peaceful uses of outer space,

Offers in any matters within the competence of COSPAR such services of COSPAR as the said Committee or the Secretary-General of the United Nations Organization may desire, and

Instructs its President to make available to the Secretary-General of the United Nations Organization any information on the COSPAR scientific activities which may seem useful towards an efficient cooperation.

.../13

RESOLUTIONS 2 - 10 WERE PROPOSED BY
THE COSPAR WORKING GROUP ON "TRACKING AND TELEMETERING"

2. Relationships with I.T.U.

COSPAR notes with satisfaction and appreciation the provision on a world wide basis of radio frequency allocations for space research in the Table of Frequency Allocations adopted by the Administrative Radio Conference of the International Telecommunications Union held in Geneva from the 17th., August through 21st., December, 1959. It also recognises the importance and value to space research of I.T.U. Resolution Number 7 relating to radio emissions from artificial satellites and other space vehicles; and I.T.U. Recommendation Number 35 relating to the convening of an extraordinary Administrative Radio Conference to allocate frequency bands for space radio-communication purposes.

It is recommended that the collaboration of COSPAR and the I.T.U. should continue and be used to the fullest extent to promote international coordination of the use of the radio frequency spectrum for space purposes. It believes that COSPAR can contribute to the studies that will now be undertaken by the permanent organs of I.T.U., the C.C.I.R. and the I.F.R.B. It is recommended that every assistance should be rendered in full collaboration with the I.T.U. in these studies by active participation in C.C.I.R./I.T.U. plenary assemblies and relevant study group meetings and also I.T.U. conferences and related preparatory work.

.../14

3. Use of Frequency Spectrum

Although the I.T.U. is the Specialised Agency in the field of international telecommunications and should provide adequate frequency allocations for all categories of services, nevertheless, it is realised that the demands for the use of the radio frequency spectrum actually exceed the present limitations of the available spectrum. COSPAR, therefore, recommends to its members that the demands on the use of the spectrum for space research be voluntarily coordinated and be consistent with the minimum required to provide the necessary space radio service.

4. Information to I.T.U.

Recognizing that the I.T.U. has under study technical questions relating to radiocommunications with and between space vehicles, the identification and control of the emissions at appropriate times, COSPAR recommends that the national scientific institutions represented in COSPAR should keep the *transmissions from satellites and space vehicles and of the plans for their control from earth, so that COSPAR can provide up-to-date information on these subjects to the I.T.U.

5. Visual Observations Groups

COSPAR considers that the work of visual observation groups is of high value, especially in the Southern Hemisphere, and should not be allowed to lapse for lack of financial support.

6. Release of Telemetering Codes and Calibrations

Although recognizing that it must continue to be the prerogative of the institution sponsoring a space experiment to determine how and where the data should be reduced and analyzed, COSPAR recommends that consideration be given by sponsor institutions to the potential desirability of international cooperation in data reduction and analysis, and recommends timely communication to other appropriate institutions of telemetry codes and calibrations for experiments in connection with which such cooperation may be deemeddesirable by the sponsor.

7. Survey of Orbiting Components

COSPAR recommends that attention be drawn to the need for a continuing survey of the various orbiting components of satellites. COSPAR will arrange for further study and investigation of this subject and draws attention to the possible significance which this study might have in relation to the interests of Commission 22 of the I.A.U.

.../15

(*COSPAR Secretariat informed of their proposals for radio-)

8. Designation of Space Vehicles

COSPAR having been advised of the present system of numbering artificial earth satellites,

(i) expresses its appreciation of the initiative of the Harvard Observatory in devising a numbering system based on astronomical precedents;

(ii) suggests that the system be continued and makes the following comments :

(a) all space, lunar and planetary probes should be included in the system;

(b) artificial satellites and space vehicles would not normally be given a number unless they have a lifetime of at least 90 minutes; however, it is suggested that the allocating agency should use its own judgement as to whether or not a designation is required for the purposes of international scientific cooperation;

(c) where more than 1 component exists the order of classification should be by numerical suffix according to brightness as in the orginal classification;

(d) in the event of more than 24 launchings in the course of 1 year the astronomical practice of prefixing the 25th. - 48th. objects by the letter α should be adopted, e.g. $\alpha\alpha$, $\alpha\beta$, , $\alpha\chi$

(iii) recommends the more extensive use of the nomenclature in scientific literature.

9. Accuracy of Observational Data

It is noted that the value of satellite observations will be enhanced if more information regarding the estimated accuracy and reliability of the data are provided. In particular, observers are requested to state whether or not corrections have been made for optical refraction or ionospheric effects and if corrections for tropospheric effects have not been made observers should supply values of local pressure, temperature and humidity so that such corrections can be made. Information on the type of equipment used and the accuracy of the timing system are also required.

10. Revision of List of Tracking Stations

COSPAR recommends that the list of satellite tracking stations drawn up during the I.G.Y. should be revised and made available to all interested workers.

.../16

RESOLUTIONS 11 - 13 ARE TAKEN FROM THE REPORT OF THE COSPAR WORKING GROUP ON "SCIENTIFIC EXPERIMENTS".

11. Special Rocket Intervals

COSPAR recommends that all nations that can do so perform meteorologcial rocket soundings during the quarterly meteorological World intervals of 1961, with especial emphasis on the January and October periods. Particular effort should be devoted to having launchings on the Regular World Days and on the special world intervals occurring within these meteorological intervals. In addition to primarily meteorological measurements, it is recommended that related geophysical and solar measurements also be made. Any of the following measurements would provide an important contribution :

(a) Temperature, pressure, density above 30 km.

(b) Winds above 30 km.

(c) Atmospheric neutral and ion composition above 30 km.

(d) Electron densities in the D-, E- and F- regions.

(e) Solar ultraviolet and X-ray intensities as a function of altitude above 30 km.

(f) Any related effects such as variations in cosmic rays and magnetic fields.

COSPAR further invites the attention of its members to the potential value of cooperative rocket sounding programs specifically directed toward geophysical, solar, and cosmic ray research, and urges the formation of such special cooperative programs.

12. Accuracy of Orbital Data

COSPAR notes that the achievement of scientific objectives is often made difficult by the lack of sufficiently accurate orbital data, stresses the urgent need to improve the quality of such data, and recommends that Working Group 1 consider this problem jointly with representatives from Working Group 2 to formulate recommendations as to the best means of obtaining the required accuracies.

.../17

13. Decontaminating and Sterilising of Space Craft.

COSPAR calls attention to the problem of contamination and infection of the planets as discussed in the January 1960 report of the Working Group II on Scientific Experiments, and recommends that experiments be undertaken to provide the basic data for quantitative specifications for use in decontaminating and sterilising spacecraft. Included should be laboratory experiments to determine the rate of growth of organisms under conditions believed to exist on Mars and Venus. Tests should also be made of the sterilizing effect of space conditions and re-entry into the atmosphere. COSPAR accepts the offer of J. Kaplan to prepare a summary and bibliography of knowninformation on Mars and Venus to inform the biologists of the kinds of environments that may be encountered and should be investigated. When sufficient data have become available COSPAR will propose definite specifications for use in sterilising space craft. In the meantime COSPAR refers launching nations to the existing CETEX document on this subject.

RESOLUTIONS 14 - 20 ARE TAKEN FROM THE REPORT OF THE COSPAR WORKING GROUP ON "DATA AND PUBLICATIONS."

14. Satellite Information

Respecting the exchange of satellite information COSPAR makes the following recommendations :

(a) Pre-Launch Information. Where, in the judgement of a launching nation, a future satellite will involve significant changes in customary frequencies, power output, orbital inclination, or observational opportunities, it should announce such changes as far in advance as practicable through SPACEWARN (see below). As a matter of courtesy, the recipients of such advance information should leave its public announcement to the launching nation.

(b) Launching Information. Within hours after a successful launching, the scientific community should be informed of this fact through SPACEWARN and by announcement in the press, together with pertinent details.

(c) Orbital Elements. As an aid to tracking, orbital elements should be distributed periodically by the launching nation via SPACEWARN. The elements to be supplied should include the following or their equivalent, with minimum desirable accuracies as indicated:

(i) the inclination of the plane and the longitude of the node to an accuracy of 1/10th. degree;

(ii) the period of the orbit to an accuracy of 1/10th. second;

(14 (c) cont.)

(iii) the eccentricity of the orbit accurate to 4 decimal places;

(iv) the argument of the perigee to an accuracy consistent with that of the other elements, depending on eccentricity;

(v) the epoch to an accuracy of 1 second.

The elements should be provided on a current basis as frequently as is required to permit observations based upon the accuracies indicated.

(d) Precise Orbits. Precise orbits which are available some time after the observations have been collected and analysed should be deposited in the World Data Centres.

15. Space Probes (or Cosmic Rockets).

Recognising that for deep space probes only specialised tracking stations can achieve useful results, and that acquisition data must be available within a very few hours of launching, COSPAR recommends that private arrangements be made between the launching authorities and the specialised tracking stations for the rapid transmission of acquisition data.

16. Communication

(a) SPACEWARN network

COSPAR considers that there should be available an international channel for rapid communication of information needed for tracking and other observational purposes, in addition to the channels necessary to, and established by, national programs. The international channel should handle primarily information of general interest and applicability. COSPAR, therefore, recommends that the World Days ("AGIWARN") network utilised for this purpose during the IGY continue to serve under the name of the SPACEWARN network. It is further recommended that the International World Days Service (IWDS) be requested to continue to coordinate these satellite rapid communications and the nations responsible for the Satellite Regional Warning Centres continue to support this phase of their work. An outline of the SPACEWARN network is given in the Report of Working Group III (para. 3.1)

(b) Launching announcements.
It is recommended that plain language launching announcements be sent without delay by the SRWC of origin to the other SRWCs and that distribution within each region proceed immediately in accord with regional plans.

(c) Current Orbital Elements. It is recommended that current orbital elements, as made available by computing centres, be distributed by the SRWC of origin to the other SRWCs, at a regular time of day, and that distribution within each region be carried out at a regular time of day, in accord with regional plans. This message should be appended to a regular daily solar geophysical data message whenever convenient.

(d) Station Predictions. It is considered that current orbital elements with rates of change, such as given in SATOR code, are the most convenient present method for efficiently distributing orbital information for large numbers of tracking and observing stations. At the same time it is recognised that station predictions are valuable if they can be supplied and distributed more promptly than orbital elements. In general, any station predictions provided should go directly from computing centres to the respective station, utilising the SPACEWARN network only under special arrangement.

(e) Reports of Tracking Observations. In general, tracking observations are sent directly from the tracking station to the computing centre of the launching agency, either by telegram or by air-letter, as appropriate. Tracking observations may be sent under special circumstances via SRWCs for forwarding by telegram, if unique or urgent, or by air-letter, as deemed appropriate.

(f) Special Messages. Launching agencies may provide special information or requests of general interest for distribution over the SPACEWARN network by telegram or air-letter, as appropriate.

(g) Communication Costs. It is understood that any communication costs for interchange among SRWCs are borne by the SRWC of origin of the message. Arrangements regarding the costs of distribution within each region are to be made between the SRWC and the recipient.

(h) Addresses for Satellite Messages. It is recommended that national members of COSPAR ascertain and communicate to the respective SRWC as to the addresses of centers or stations requiring messages of categories (b), (c) and (d). Such members should also determine what, if any, changes or improvements are necessary to assure effective communications and coverage within their areas, and should make appropriate recommendations to the Chairman of Working Group III, who will then engage in appropriate discussions with the I.W.D.S.

(b) Launching announcements.
It is recommended that plain language launching announcements be sent without delay by the SRWC of origin to the other SRWCs and that distribution within each region proceed immediately in accord with regional plans.

(c) Current Orbital Elements. It is recommended that current orbital elements, as made available by computing centres, be distributed by the SRWC of origin to the other SRWCs, at a regular time of day, and that distribution within each region be carried out at a regular time of day, in accord with regional plans. This message should be appended to a regular daily solar geophysical data message whenever convenient.

(d) Station Predictions. It is considered that current orbital elements with rates of change, such as given in SATOR code, are the most convenient present method for efficiently distributing orbital information for large numbers of tracking and observing stations. At the same time it is recognised that station predictions are valuable if they can be supplied and distributed more promptly than orbital elements. In general, any station predictions provided should go directly from computing centres to the respective station, utilising the SPACEWARN network only under special arrangement.

(e) Reports of Tracking Observations. In general, tracking observations are sent directly from the tracking station to the computing centre of the launching agency, either by telegram or by air-letter, as appropriate. Tracking observations may be sent under special circumstances via SRWCs for forwarding by telegram, if unique or urgent, or by air-letter, as deemed appropriate.

(f) Special Messages. Launching agencies may provide special information or requests of general interest for distribution over the SPACEWARN network by telegram or air-letter, as appropriate.

(g) Communication Costs. It is understood that any communication costs for interchange among SRWCs are borne by the SRWC of origin of the message. Arrangements regarding the costs of distribution within each region are to be made between the SRWC and the recipient.

(h) Addresses for Satellite Messages. It is recommended that national members of COSPAR ascertain and communicate to the respective SRWC as to the addresses of centers or stations requiring messages of categories (b), (c) and (d). Such members should also determine what, if any, changes or improvements are necessary to assure effective communications and coverage within their areas, and should make appropriate recommendations to the Chairman of Working Group III, who will then engage in appropriate discussions with the I.W.D.S.

..../20

(i) <u>Codes</u>. It is considered that the codes given in IGY Annals, Vol. VII, Part I, Section VI "Rapid Communications for IGY Earth Satellite Programs" are adequate for the present. It is recommended that the national members make suggestions for modification of existing codes or proposals for new codes to the Chairman of Working Group III, following in general the procedure established in (h).

(j) <u>Effectiveness of Communcations.</u> The IWDS is requested to provide a report on the working of the SPACEWARN network at the earliest opportunity, for consideration by Working Group III so that it may consider steps to provide improvements.

17. <u>Scientific Information</u>

With respect to exchange of scientific information COSPAR makes the following recommendations :

(a) <u>Descriptive Experimental Information</u>. This should be sent to COSPAR for distribution to all members of COSPAR within a few weeks after launching and should include:

(i) Nature of the experiments and objectives.

(ii) Other information needed by investigators working in the same or related fields, in cases where their cooperation is desired.

(b) <u>Raw Data</u> (Original Data, as tapes). Such data should be stored for as long as practicable.

(c) <u>Reduced (calibrated) Data</u>. Wherever possible, the practice of depositing reduced, calibrated data in the World Data Centers should be encouraged.

(d) <u>Analysed Data</u>. Supporting data should be included in the body or appendix of a published research paper, or in interim reports, or, if this is not practicable, should be sent to the World Data Centers in tabulated form.

(e) <u>Availability of Data</u>. Reference to the availability of all forms of these data (17 b, c, d.) should be included in the published research paper.

..../21

18. COSPAR Publications.

It is recommended that COSPAR undertakes the following publications :

(a) Monthly Bulletin. A monthly bulletin reporting COSPAR activities, the launching of scientific rockets and satellites, and noting special articles or papers as well as other news items, should be published monthly. It is proposed that the format be very simple and inexpensive, limited to two or three pages per month. An early issue should include a list of satellites and space probes launched to date, together with pertinent summary data. It is recommended that necessary part-time editorial assistance be obtained in The Hague. It is anticipated that editorial, printing, and mailing costs should not exceed $2,000 per annum.

(b) Rocket Week Reports. COSPAR should issue, under cover, an annual compilation of flight summaries representing the rocket launchings conducted during International Rocket Weeks.

(c) Consolidated lists of sources. It is proposed that the Chairman of the Working Group III solicit from the national members lists of journals in which reports concerned with space research are normally published. It is recommended that COSPAR undertake to publish a consolidated list for distribution to COSPAR members.

19. World Data Centers

COSPAR recommends that each World Data Center prepare and circulate a complete catalogue including published and unpublished papers and data held in the Center and related institutions. Such catalogues should be distributed to COSPAR members and other World Data Centers every six months, covering material received in the previous six months. The semi-annual catalogues should be cumulated every two years.

20. Bibliographies

COSPAR recommends that each national scientific institution adhering to COSPAR prepare a bibliography of its published reports and papers in the space sciences, such bibliography to be appended to its annual report to COSPAR and deposited with all the World Data Centres.

.../22

RESOLUTIONS 21 - 24 WERE PROPOSED DURING THE SESSION ON JANUARY 16th.

21. COSPAR calls attention to the need for interdisciplinary studies of the relationship between various scientific observations of the Earth and Cosmos, with emphasis on correlation of all aspects of a particular event or phenomenon. Working Group II is requested to take appropriate steps, in consultation with other interested ICSU organisms, to ensure the carrying out of such a detailed study of some significant solar-terrestrial event, such as those of July 1958 or Mid-August 1959, to be mutually agreed on by the Members of the Working Group as potentially most advantageous from the viewpoint of availability of pertinent data. A full scientific report of this study, suitable for publication, is to be prepared, if possible, prior to the next meeting of COSPAR.

22. COSPAR recommends that Working Group I study scientific requirements and methods for applying optical and ionospheric corrections to tracking observations, and that it formulate recommended procedures for making such corrections for presentation to COSPAR at its next meeting.

23. COSPAR authorizes its Executive Council to organize informal ad hoc working groups on specific questions of current scientific importance. These ad hoc working groups should be composed of scientists selected on the basis of competence without regard to nationality and should be convened whenever needed, not necessarily in connection with COSPAR meetings. COSPAR members are invited at any time to propose questions having significant scientific interest and practical importance to the world program of space research, for consideration by such ad hoc working groups

24. <u>Representation of COSPAR at meetings of international interest where problems of space research are discussed</u>.

COSPAR resolves that :

(i) The COSPAR Secretariat keep an up-to-date list of forthcoming meetings of international interest where problems of space research will be discussed.

(ii) The <u>minimum</u> provisions which the COSPAR President will take for each such meeting, will be the designation of one of the participants of such a meeting as the representative of COSPAR.

(iii) The <u>minimum</u> duties of such a representative will be to send to the COSPAR Secretariat immediately after the meeting a brief report outlining the subject matter discussed, major results achieved and possible improvements of liaison with the body concerned.

(iv) These minimum provisions be amplified, as the situation may require, in the case of more important meetings.

(v) The list mentioned sub (i) and the reports, or abstracts of the reports, mentioned sub (iii) be periodically published by COSPAR in its Information Bulletin or be otherwise circulated to the persons on COSPAR's master mailing list.

LIST OF PARTICIPANTS

Third COSPAR Meeting

ER, P.	France	Advisor to Delegate for France.
EXANDER, P.	U.K.	Member of W.G.2.
INOV, U.	U.S.S.R.	Advisor to Delegate for USSR.
RTELS, J.	W. Germany	Chairman of W.G.2. Delegate for W. Germany
NON, W.J.G.	U.K.	Member of W.G.1.
GONRAVOV, A.A.	U.S.S.R.	Delegate for USSR. Vice-President of [illegible]
AMONT, J.	France	Member of W.G.2.
YD, R.L.F.	U.K.	Member of W.G.2.
OGLIO, L.	Italy	Observer for Italy
PMAN, J.	Canada	Member of W.G.2.
ENG, K.T.C.	Academia Sinica, Taiwan, China - Observer.	
ANCAGLINI, H.	Argentina	Delegate for Argentina
VIES, J.G.	U.K.	Advisor to Delegate for URSI
ORKIN, M.	Belgium	Delegate for IUB . . .
ASER, R.	U.K.	ICSU Advisor
UTKIN, A.W.	U.S.A.	Advisor to Delegate for USA
YER, J.H.	U.S.A.	Observer for I.T.U.
TANAKA, T.	Japan	Delegate for Japan
GGS, H.J.	Australia	Advisor to Delegate for Australia.
OGG, W.	South Africa	Delegate for South Africa
UTERMANS, F.G.	Switzerland	Observer for Switzerland
LST, H.C. van de	Netherlands	Delegate for IAU. President of COSPAR
XLEY, L.G.H.	Australia	Delegate for Australia
LLMANN, H.K.	U.S.A.	Advisor and Assistant to COSPAR
PLAN, J.	U.S.A.	Delegate for IUGG
CLAVÈRE, G.	France	Observer for CIG
VELL, A.C.B.	U.K.	Delegate for URSI
EDA, K.	Japan	Member of W.G.2.
RK, J. van de	Netherlands	Observer for ITU
ASSEY, H.S.W.	U.K.	Delegate for UK. Member COSPAR Bureau
ITRA, A.P.	India	Chairman of W.G.3.
ORE, A.F.	U.K.	Advisor to Delegate for UK.
LLER, P.	France	Delegate for France.
ICOLET, M.	Belgium	Delegate for Belgium
WELL, H.E.	U.S.A.	Member of W.G.2.
OVICOV, N.	U.S.S.R.	Advisor to Delegate for USSR
DISHAW, H.	U.S.A.	Member of W.G.3.

..../2

AVEY, R.C.	U.S.A.	Advisor to Delegate for USA
RTER, R.W.	U.S.A.	Delegate for USA. Vice-President of COSPAR.
ESSEY, B.G.	U.K.	Member of W.G.3.
GHINI, G.	Italy	Observer for Italy
BINS, M.O.	U.K.	Advisor to U.K. Delegate
DERICK, H.	U.S.A.	UNESCO Observer.
SCH, J.	France	Member of W.G.3.
SE, D.C.	Canada	Delegate for Canada. Member of W.G.2.
SER, J.B.	U.S.A.	Delegate for IMU
, M.	France	Delegate for IUTAM. Member of COSPAR Bureau.
APLEY, A.H.	U.S.A.	Representative IWDS.
ITH, F.B.	U.S.A.	Member of W.G.1.
LDKAMP, J.	Netherlands	Observer for the Netherlands.
RESHETIN, V.	U.S.S.R.	Assistant to Delegate for USSR.
NOV, S.N.	U.S.S.R.	Advisor to Delegate for USSR.
XLER, H.	U.S.A.	Member of W.G.2.
NN, W.	Poland	Delegate for Poland. Member of COSPAR Bureau.

SPAR Administrative Secretary.- Mr. F.H.M. van Straelen.

REPORT OF WORKING GROUP I
ON TRACKING AND TELEMETERING.

This report consists of minutes of the Working Group meetings. The resolutions referred to in the amended form adopted by COSPAR are found in the COSPAR report, resolutions 2 - 10.

ATTACHED: Appendix B1, Abstracts of Final Acts of the I.T.U. Conference

At a joint meeting of Working Group 1 (Tracking and Telemetering) and Working Group 3 (Data and Publications) held at 11.30 am. on Friday, 8 January 1960 in Nice, France.

Present:

A.C.B. Lovell	- Acting Chairman of W.G.1.	U.K.
A.P. Mitra	- Chairman of W.G.3.	India
W.J.G. Beynon		U.K.
J.H. Chapman		Canada
K.T.C. Cheng		Academia Sinica, Taiwan, China
J.G. Davies		U.K.
A.W. Frutkin		U.S.A.
T. Hatanaka		Japan
H.J. Higgs		Australia
D. Hogg		S. Africa
H.C. van de Hulst		Netherlands
H.K. Kallmann		U.S.A.
A.F. Moore		U.K.
P. Muller		France
H. Odishaw		U.S.A.
R.C. Peavey		U.S.A.
R.W. Porter		U.S.A.
B.G. Pressey		U.K.
H. Roderick		U.S.A. (UNESCO)
J. Rösch		France
J.B. Rosser		U.S.A.
M.O. Robins		U.K.
F.B. Smith		U.S.A.
L.G.H. Huxley		Australia

1. Space Research Frequencies

Professor H.J. van de Hulst reported on the meeting of the International Telecommunications Union held in Geneva in 1959 and presented a report on the resolutions (Appendix B1) of the conference relating to space research work. It was noted that at the conference, the first for over a decade, 13 bands had been allocated for space research activities but that the request for a 5 M/cs band allocation has not been granted and that no allocation had been made between 400 and 1427 M/cs. The 13 bands range from 10003 K/cs to 31.8 G/cs (1 Gigacycle = 1000 M/cs) five of which are primary allocations, the rest being secondary. It was noted that the 136 M/cs allocation had replaced the 108 M/cs one.

It was reported that space research had been accepted as an activity requiring an allocation of frequencies and that claims for such allocations would have to be presented at all regional and other I.T.U. committee conferences. In order that work may be put in hand regarding further claims and also the elevation of some allocation from the secondary to the primary degree the I.T.U. conference in Resolution No. 7 and recommendation No. 35 had instructed C.C.I.R. to examine all such claims and instructed the Administrative Council to decide whether a conference should be convened in 1963 to discuss such matters.

The Working Group wishes to record its deep appreciation of the services of Professor van de Hulst in devoting so much of his effort in securing this recognition from the I.T.U. COSPAR resolutions 2 and 4 refer (see report, pages 13 & 14).

2. Interference caused by space research operations

Dr. Chapman (Canada) reported on the proposed satellite experiment in which frequencies in the range 3 - 15 M/cs would be swept in 15 secs. and the properties of the return ray telemetered to ground so as to determine the electron density above the F layer maximum. This experiment in which Canada, USA and UK were interested was assumed to have the status of the usual 150 ground based ionospheric sounders which were tolerated on a non-interference basis. The design of the power supplies had not yet been finalised for if a pulse sounder was to be used it was likely that the power required for the valves would make continuous operation impossible, whilst a C-W sounder would avoid this restriction. In the former case command telemetery would be necessary and the code would only be known to the Canadians and their associates so as to conserve the batteries, whereas in the latter case any country might command the transmitter. It was reported that this experiment might be launched late in 1961 at an inclination of 80° and that the maximum power would be 100 watts with an average power of 1 watt, the telemetering power being 1 watt on 136 M/cs. It was commented that COSPAR should not support space science experiments simply because they were already tolerated on the ground, for in this particular instance the local ground effects were being replaced by world-wide interference when frequencies outside the I.T.U. allocation were being swept.

It was remarked that spot frequency measurements would not interfere with galactic noise work and it was stated that such an experiment was being designed in the U.S.A. and it had been hoped that this type of sounder would have been the first to be ready in Canada.

It was stated that the lifetime of the experiment might be one year although power considerations might limit it to 3 months and it was suggested that operation on one day in 7 might be advantageous as the length of the period of operation of one sounder was important.

It was remarked that with 4 interrogating stations in North Canada and 6 interrogations daily there would only be 24 moments daily in which momentary interference would occur and that only in North Canada if the command system were so arranged.

Radio astronomers stated that it was difficult for them to work below 20 M/cs and very difficult below 12 M/cs even at sunspot minimum which was now being approached and one of their real fears was that the transmitters might fail. It was pointed out that the chemical batteries had a limited life even if the solar cells did not and that intentional failure devices were now being designed.
COSPAR resolution No.3 refers.

At the resumed meeting at 2pm.:-

3. Predictions

It was reported that NASA wished to cease circulating predictions specially compiled for each of several hundred stations and replace them by a single general message containing the orbital elements alone, now that simple charts for obtaining site predictions had been devised (U.S., IGY Satellite Report No. 7). It was possible that such arrangements might give improved predictions for the increased accuracy would only have to be obtained in the one calculation of the orbital elements. The rate of change of the elements would also be circulated.
COSPAR resolutions No. 14 refers (See report, page 17)

.../4

4. The AGIWARN Service

The growth of and use of the AGIWARN Service particularly with reference to its use in connection with the transmission of launching messages was explained, it being remarked that an international system of observations required an international communication system. It was stated that NASA has a communications system of its own for the stations in its own system but as cover is not available elsewhere and as more countries may participate, it was felt that the system must be maintained. COSPAR resolution No. 16 refers (see report, pages 18, 19 &20.)

5. Visual observations

It was reported that there were comparatively few visual observers in the Southern hemisphere and as there was a chance that such work might cease due to lack of finance it was decided to support this type of work which was important in the early and late stage of satellite life and also for tracking objects which had been lost by more complicated apparatus with smaller fields of view.
Resolution No. 5 refers (see report, page 14)

At the resumed meeting held at 3 pm. om 9 January 1960:

Present:

A.C.B. Lovell	- Acting Chairman W.G.1.	U.K.
J.H. Chapman		Canada
K.T.C. Cheng	Academia Sinica,	Taiwan, China.
J.G. Davies		U.K.
D. Hogg		S.Africa
V. Barinov		U.S.S.R.
L.G.H. Huxley		Australia
A.F. Moore		U.K.
P. Muller		France
N. Novikov		U.S.S.R.
M.O. Robins		U.K.
J.B. Rosser		U.S.A.
F.B. Smith		U.S.A.

FINAL ACTS of the I.T.U. Administrative Radio Conference
Geneva, August 17 - December 21, 1959. Appendix B1

Abstracts prepared for COSPAR Working Group on Tracking and Telemetering

January 5, 1960.

Radio Regulations Art. 1 — Terms and Definitions

1 - 70 Space Service : A radiocommunication service between space stations.

1 - 71 Earth-Space Service : A radiocommunication service between earth stations and space stations.

1 - 72 Space Station : A station in the earth-space service or the space service located on an object which is beyond, or intended to go beyond, the major portion of the earth's atmosphere and which is not intended for flight between points on the earth's surface.

1 - 73 Earth-Station : A station in the eatth-space service located either on the earth's surface or on an object which is limited to flight between points on the earth's surface.

Radio Regulations Art. 5 — Frequency Allocations

3 - 13 to 5 - 20 Definitions of different ranks of allocation : primary, permitted, secondary, and additional services

All following frequencies are noted for space service and earth-space service :

Frequency		Unit	Footnote Number	Rank
10003	- 10005	kc/s	161a	add. secondary.
19990	- 20010	kc/s	168a	add. secondary
39986	- 40002	kc/s	175g	add. secondary
136	- 137	Mc/s	194b	primary, research
183.1	- 184.1	Mc/s	203d	add. no harmful interference.
400	- 401	Mc/s	194b	primary, research
1427	- 1429	Mc/s	194b	primary, research
1700	- 1710	Mc/s	194b, 219a	secondary, research, n.h.i.
2290	- 2300	Mc/s	194b, 219a	secondary, research, n.h.i.
5250	- 5255	Mc/s	194b, 226a	secondary, research
8400	- 8500	Mc/s	194b, 229c	secondary, research
15.15	- 15.25	Gc/s	194b	primary, research
31.5	- 31.8	Gc/s	194b	primary, research

All of these loc ns are worldwide.

RESOLUTION No. 7 — Relating to Radio Emissions from Artificial Satellites and Other Space Vehicles.

The Administrative Radio Conference, Geneva, 1959,

considering :

a) that it is desirable to study the question of identification for radio emissions from satellites and other space vehicles;

b) that it is desirable to study the question of providing for the cessation, at appropriate times, of radio emissions from satellites and other space vehicles,

asks :

1. the C.C.I.R. to study the above-mentioned questions;

2. Members and Associate Members of the Union launching satellites and other space vehicles to give consideration to the above-mentioned problems and to present the results of their study to the C.C.I.R.

....

RECOMMENDATION no. 35 — Relating to the Convening of an Extraordinary Administrative Radio Conference to Allocate Frequency bands for Space Radiocommunication Purposes.

The Administrative Radio Conference, Geneva, 1959,

considering :

a) that several delegations participating in the Administrative Radio Conference have proposed to allocate frequencies for space research purposes only on the basis of the research requirements for the next few years;

b) that the C.C.I.R. has already under study technical questions relating to radiocommunication with and between space vehicles;

c) that the Administrative Radio Conference has recommended to the C.C.I.R. that the identification and control of space vehicles emissions be questions for study by the C.C.I.R.;

d) that until the results of some space research programmes are available the extent to which space radiocommunication services and other radiocommunication services may share frequencies, without harmful interference, cannot be accurately assessed;

e) that additional research experience and the results of studies by the C.C.I.R., and other interested organizations, relating to space radiocommunications are essential before it will be feasible for the I.T.U. to take decisions on firm frequency allocations for space radiocommunication purposes;

and bearing in mind :

that the I.T.U. is the specialized agency in the field of telecommunications and it is necessary for the I.T.U. to provide adequate frequency allocations for all categories of space radiocommunications as soon as the results of research and studies by the C.C.I.R. and other interested organizations make this possible;

..../3

<u>recommends</u>:

1. that an Extraordinary Administrative Radio Conference be convened, in principle during the latter part of 1963 with a duration of approximately one month and with an agenda which should include the following basic items:

1.1 to examine the technical progress in the use of radiocommunication for space research and the results of technical studies by the C.C.I.R. and other interested organizations;

1.2 to decide in the light of this examination, on the allocation of frequency bands essential for the various categories of space radiocommunication;

1.3 to consider whether there is a continuing need for the allocation of certain frequencies for space research purposes and, if so, to take appropriate action in this regard;

1.4 to adopt, if such action is considered desirable, new provisions revising the Radio Regulations to provide for the identification and control of radio emissions from space vehicles, taking into account possible Recommendations of the C.C.I.R.;

2. that the Administrative Council review the situation during its 1962 and 1963 ordinary sessions on the basis of information received from Members and Associate Members of the Union, the C.C.I.R. and other interested organizations. Shloud the Administrative Council decide that there is sufficient justification for the convening of the Extraordinary Administrative Radio Conference in 1963, it shall recommend to Members of the Union the date and place for the Conference and its Agenda;

<u>and invites</u>:

those Members and Associate Members of the Union which launch satellites during the period of space research before the convening of the Extraordinary Administrative Radio Conference referred to above, to keep the Administrative Council, and the relevant technical organs of the I.T.U., informed of the frequencies used and the technical progress achieved in the use of radiocommunication for space research purposes.

REPORT OF WORKING GROUP II
ON SCIENTIFIC EXPERIMENTS

This report consists of minutes of the Working Group meetings.

The resolutions referred to, in the amended form adopted by COSPAR, are to be found in the COSPAR report, resolutions 11-13.
Attached:

APPENDIX C 1 Cetex recommendations
APPENDIX C 2 Letter from Professor Massey concerning U.K. plans (with Annex)

Attendance

Professor J. Bartels - Chairman
Geophysikalisches Institut, Göttingen, Germany.

Dr. H.E. Newell - Reporter

List of participants in meetings of W.G.II on January 8 and 9:

P. Alexander
W.J.G. Beynon
J. Blamont
R.L.F. Boyd
M. Florkin
J. Higgs
J. Kaplan
K. Maeda
H.S.W. Massey
M. Nicolet
W. Priester
D.C. Rose
A.H. Shapley
S.N. Vernov
H. Wexler

../..

1. ROCKET INTERVALS

1.1. Rocket Week 1959. Reports received indicated that the Rocket Week 1959 has proceeded satisfactorily.

1.2. Rocket Interval 1960. The Working Group recommended that COSPAR confirm 16 to 22 September 1960 as an International Rocket Interval.

1.3. Rocket Interval 1961. The Working Group noted the recent WMO recommendation that World Meterological Intervals be continued after the IGY and embrace the periods:

16 - 25 January

16 - 25 April

16 - 25 July

16 - 25 October

It was agreed that rocket firings devoted to upper atmosphere and solar observations important to meteorology should be made during all of these intervals, but that emphasis should be placed on the January and October intervals. The importance of rocket intervals devoted to other geophysical objectives was also emphasized.

1.3.1. Specific points brought out in the discussion of rocket world intervals are:

(a) It is important to decide on the things to be done in a rocket interval far enough in advance that the experimenters can carry out their planning and preparation in good time.

(b) It is important for COSPAR to point to the areas of research that can profit by international rocket intervals, and to make specific recommendations.

(c) Although the investigations associated with meteorology should be made during the meteorological rocket intervals, there are many other types of investigation that may well require other special rocket intervals not coincident with the meteorological intervals.

(d) It may be desirable to make many measurements at identical universal times and others at identical local times, but that at the present stage of experience with rockets, it is not reasonable to insist on such accuracy of timing of firings.

(e) The following measurements are of particular importance to the meteorological investigations: temperature, pressure, density, winds, ion composition, neutral composition, electron densities, and solar ultraviolet and x-ray intensities as a function of altitude above 30 kilometres.

../..

(f) In the meteorological studies program it is important to have rockets fired at the time of a solar flare.

(g) A wide range of techniques have been developed that can be used in the meteorological studies program, including: optical spectrometry, mass spectrometry, ionization gages, sodium clouds, falling spheres, radar-chaff, grenade explosions, propagation measurements.

1.3.2. COSPAR resolution 11 refers (see report, page 16)

2. THE BIOLOGIC PROBLEM

The Working Group noted the importance of providing specific quantitative guidance for the use of launching nations in sterilizing and decontaminating cosmic rockets that may impact a planet. It was further noted, however, that additional data must be obtained before appropriate specifications can be prepared. The following redommendation is, therefore, put forth.

2.1. Recommendation of Working Group 2 concerning contamination of Mars and possibly other Planets. The working group having a responsibility for the execution of extra terrestial experiments asks COSPAR to give urgent attention to the problem of contamination of Mars and other planets. At the second COSPAR meeting, the report of CETEX was adopted which stressed the absolute necessity to avoid contamination of the planets if some of the most exciting prospects of space research were not to be endangered. In view of the rapid progress in space flight, action is called for now.

For convenience the working group proposes to divide the problem of contamination into (a) Introduction of foreign material which contains no organisms capable of growth, and (b) Infection due to organisms which multiply on the planets.

2.I.I. Introduction of foreign material: While the group believes that this is very undesirable as it could lead to far reaching changes by initiating new reactions, yet it feels that no regulation against experiments that carry with them the chance of a landing, have a possibility of acceptance. To limit harm to future experiments, COSPAR is advised to urge that all steps be taken to minimise the amount of foreign matter introduced and that a replica of any pay load likely to land be kept for reference purposes. In addition, the working group urges that steps be taken to assure that debris may be identified with certainty.

2.1.2. Infection : This is the major problem and its importance cannot be over emphasized. Unfortunately there is at present virtually no data that makes it possible to assess the degree of sterility that is necessary and no specification can be given to those responsible for sterilising a space vehicle. The working group feels that the following experiments should be immediately put underway to provide some basis for the specification that must eventually be proposed.

(a) Laboratory experiments to determine the growth rate of organisms under conditions which are believed to exist on Mars (and possibly Venus). In this way we would learn of the type of organisms to guard against and the rate at which infection is likely to spread bearing in mind the presence of space vehicle debris in the environment.

(b) The danger that viable organisms are picked up by sterilised vehicles during its flight through the atmosphere into space is difficult to estimate since any organisms picked up in this way would be subject to the sterilising effects of high vacuum, high energy radiations etc. encountered during flight. Again laboratory experiments designed to simulate these conditions would provide a pay load deliberately infected with readily identifiable organisms and to measure the sterilising effect of passage into space. Also, the effect of re-entry conditions can be checked.

2.1.3. The working group recommends that COSPAR immediately inform all national adhering members of the great need for these experiments and that COSPAR should ask them to try and arrange for these microbiological experiments to be carried out. It is further recommended that COSPAR ask experts to communicate with Dr.J.Kaplan who will prepare a summary and bibliography that will suggest to biologists the kind of environments that may be encountered and that should be investigated. When sufficient data have become available COSPAR should propose definite specifications for use in preparing space craft.

2.1.4. In the meantime, COSPAR should refer launching nations to the existing CETEX document on this subject (Appendix C 1).

COSPAR resolution 13 refers (See report page 17)

3. COMMENTS ON SCIENTIFIC ASPECTS OF PROPOSED UNITED KINGDOM SATELLITES

The Working Group reviewed the scientific experiment proposed by the United Kingdom for inclusion in a satellite to be launched by the United States. These are described in a letter from Prof. Massey to President Van de Hulst, given here as Appendix C 2.

3.1. The Working Group feels that the proposed experiments are very important ones to carry out. In particular, there is great advantage in performing the proposed ion and electron measurements with the geometries proposed, which are different from those used by other experimenters in the past.

4. ADVANCE NOTIFICATION OF EXPERIMENTS

The Working Group notes that considerable scientific benefit would accrue from some experiments if observers with equipment for specialised observations know in advance what experiments are proposed for future launchings and were given in confidence, shortly before launching, relevant position and time predictions. For example wide cooperation in determining the temperature of interplanetary space could be achieved by alerting appropriate scientists of the intention to create a sodium cloud in space.

4.I. Recommendation on Advance Notification of Experiments

The Working Group recommends that COSPAR develop means for achieving advance notification of experiments. It is further recommended that a nation originating information on an experiment also specify the distribution to be made.

5. ACCURATE ORBITAL DATA

Members of the Working Group felt very strongly that more accurate actual orbital data are needed than have been produced in the past. These data are needed for studying ionospheric and atmospheric conditions, including short term and spatially localized effects. It was thought that additional tracking stations may be needed to meet the requirement for more accurate data.

COSPAR resolution 12 refers (see report page 16)

The Hague,
March 9 - 10,
1959.

SECOND MEETING

of the Ad-hoc Committee on

Contamination by Extra-terrestrial Exploration,

(C E T E X)

Summary Recommendations

CETEX was established in 1958 by ICSU to meet once to find out if the problem of contamination of extra-terrestrial objects by space vehicles represents a real problem. The report of this meeting, which was held in May 1958, was that in the committee's view there is a real possibility that early expe ments might spoil subsequent research. The committee therefore proposed to ICSU that a code of conduct be drawn up for space research with particular reference to the allocation of priorities and sequences of different experiments. CETEX stressed that such a report would require the active participation by experts, especially from the field of rocket technology. ICSU accepted this recommendation and at its general meeting in Washington in October 1958 asked CETEX to hold a second meeting. At the same time ICSU requested the National Academies of the USA & USSR to assist CETEX with experts in rocket technology and with prepared documents. CETEX at its second meeting held at The Hague in March 1959 was able only to start its assigned task because the complexities of the problem made it impossible for the necessary detailed technical information to be available.

In the interval between the first and second meeting, COSPAR has been formed by ICSU to coordinate world-wide space research and this new body enjoys the suport of the American and Russian Academies. CETEX feels that the detailed functions proposed for its second meeting form an integral and important part of the duties of COSPAR and at this meeting CETEX confined itself to the general formulation of the problem and review of its initial report which has been slightly modified.

1. GENERAL PRINCIPLES GOVERNING SPACE RESEARCH

(i) Space research offers a challenge and opportunities which should appeal to the most imaginative minds. The greatest encouragement must be given to novel and unconventional approaches and no proposal should be sanctioned which would hamper the experimenters freedom of action unless there are compelling reasons. On the other hand, equally imaginative thinking is required when considering possible complications which can follow a particular type of experiment.

..../2

(1. (i) cont.)

Surprises are certain and unlikely possibilities must be borne in mind when dealing with the problem of contamination which is better defined as the problem of reducing the risk whereby one experiment may spoil the situation for other subsequenct enquiries. The question of deciding whether such a conflict is likely to arise can best be dealt with by a committee or working group engaged in planning, or advising on scientific experiments.

(ii) Ideally scientists should be asked to inform COSPAR as early as possible of each space experiment which is envisaged and of the methods to be used in its execution. The broadly based committee of COSPAR containing scientists from all disciplines may be able to see much more clearly than the space research specialists, possible conflicts introduced by such experiments and may be able to suggest ways of overcoming these difficulties.

(iii) There are a number of obvious and necessary experiments which are bound to be done and here the COSPAR working group dealing with experiments may be able to suggest priorities. While it may not be possible to avoid all types of contamination, a proper sequence can ensure that the collection of data is not thereby hindered. For example, CETEX recommends positively that no "soft" landing, which requires the release of large quantities of gases, should be made on the moon until experiments have been successfully carried out - or at least all reasonable attempts made - to determine the nature of the moon's atmosphere.

(iv) In view of the great uncertainties which face space research, all operations which are not capable of conveying meaningful scientific data are to be discouraged even if they do not appear to carry with them a known source of contamination. Risks with the unexpected must be taken, as otherwise no space exploration is possible, but such risks must be justified by the scientific content of the experiment.

2. <u>CONTAMINATION ENDANGERING PHYSICAL AND CHEMICAL STUDIES</u>

(i) <u>The Moon's Atmosphere</u> The Moon's atmosphere contains only a small amount of matter (it is estimated at less than 100 tons) and is therefore extremely vulnerable to contamination. The release on the surface of any amount of volatile material (having a molecular weight greater than 60) within this range of magnitude such as might be given off from explosions for marking purposes or to slow down the vehicle for "soft" landings is likely to remain on the moon. Another factor which a change in the lunar atmosphere might bring about is an upset in the thermal equilibrium and careful computation will be required before the magnitude of this effect can be assessed. The possibility that the impact of a rocket vehicle may itself be sufficient to alter the atmosphere by releasing trapped gases was rejected because the moon's surface must occasionally be subject to bombardment by heavy meteorites.

.../3

(2. (i) cont.)

The release of any chemical marker on the moon surface is therefore objectionable if it involves tons of material. If it has to be done, a flare releasing material quite unlike that normally present in the lunar atmosphere should be used so that in subsequent investigations it can be clearly recognised as a contaminant introduced by man. Both in this connection and because of increased ease in detection, a flare produced by sodium could be considered for this purpose. The sodium D lines could be detected at low intensities if a monochromator is used to cut out scattered light of other wavelengths. Probably the quantity of material required to be visible through a telescope, though not to the naked eye, would be insufficient to cause serious contamination of the atmosphere.

The possibility that a flare of this type might disturb the lunar atmosphere due to the ionization of the sodium atoms by sunlight has been considered but such an effect is unlikely to persist for long periods.

From the foregoing it is clear that detailed exploration can very easily modify the lunar atmosphere which should, if at all possible, be studied spectroscopically from either earth or moon satellites. An accidental hit by a vehicle which has failed to orbit would probably not be serious, since the moon's surface must occasionally be subject to bombardment by heavy meteorites and the release of trapped gases by impact will not, therefore, cause a departure from natural conditions.

(ii) Moon Dust The possibility that valuable information concerning cosmic dust may be lost by disturbing the moon's surface has been considered but is unlikely to be serious. Analysis of the moon's dust can only provide a very incomplete picture of cosmic dust because many of the constituents will be volatilized by solar radiation. The chemical composition of the dust on the moon's surface is of the greatest interest to a wide range of sciences. Knowledge of changes of composition at different levels would also be informative but may be difficult to interpret since bombardment by meteorites is likely to disturb the dust. For this reason mixing of some of the dust by rocket impact is unlikely to result in the loss of information.

The suggestion has been made in the recent scientific literature that there are unstable structures of a high free energy content, (i.e. containing a high concentration of free radicals) on the moon, which may be caused to react explosively on coming into contact with organic substances from the earth. The suggestion has therefore been made that great care be taken to exclude organic substances from space vehicles likely to impact on the moon. The Committee could not support the view that such a hazard existed since such free radical structures would be triggered off by any impact which caused intimate mixing. Meteorites or some corpuscular radiation would act as a fuse and initiate an explosive chain reaction. The man-made object would do no more harm in this respect.

.../4

(iii) Radioactivity A serious danger of spoiling the moon's dust will come from nuclear explosions. These will release fission products which, under the conditions of extreme vacuum will enter the moon's atmosphere and be rapidly distributed. These radioactive atoms will be in a highly reactive form and on coming into contact with moon dust may form involatile compounds. In this way the whole surface of the moon may acquire additional radioactivity which may interfere with subsequent radiochemical analyses that could be of the greatest value in particular for the problems relating to the history of the moon. The explosion of a fusion device is likely to be more serious than that of a fission bomb since the former will give rise mainly to volatile radioactive products, notably tritium, whereas the bulk of the volatile fission products are rare gases which will not combine with the moon dust. However, the range of the small particles by which fission bomb activity is spread is likely to be very great on the moon and a serious danger of contam-ination would undoubtedly arise.

Although the relative extent of the contamination of the planets from a nuclear explosion would be very much smaller than in the case of the moon it may nontheless be sufficient to interfere with detailed radiochemical analyses under certain conditions. Also the effect of introcuding radioactivity on another planet where there may be entirely different levels of background radiation from those found on earth could greatly influence any form of life found there. Although the objections against nuclear explosions on Mars and Venus may not be as compelling as in the case of the moon, they are nevertheless well justified until more information is available.

3. BIOLOGICAL CONTAMINATION

Recommendation for immediate action : The sterilization of space vehicles to prevent the spreading of spores and other terrestrial micro-organisms in the solar system is likely to present a number of technical problems that may not be easy to solve. CETEX suggest that COSPAR initiate a study immediately of the methods by which the inside of space vehicles can be sterilised, bearing in mind the presence of delicate instruments that must not be damaged. As soon as possible methods should be published by which this can be achieved and it should be urged that all space probes be sterilised in this way. Although CETEX feels that the possibility that life can persist on the moon is sufficiently remote to justify being neglected, all moon probes should be sterilised so that the difficult techniques of sterilisation may be worked out in practice.

The outside of space vehicles need not be sterilized since exposure to the unfiltered solar radiation during flight will destroy all micro-organisms which have settled on the shell. The need for sterilization is only temporary, Mars and possibly Venus need to remain uncontaminated only until study by manned space ships becomes possible.

(3 cont.)

(i) Contamination of the Moon by living cells There is no reasonable possibility by which the introduction of cells such as spores or bacteria might give rise to life on the moon of the same type (i.e. containing DNA) as on earth which might confuse later investigators. There are no cells on earth which grow or multiply in the absence of water and at the high vacuum of the moon no water can exist on its surface.

(ii) Contamination of Mars and Venus There is a possibility of biological contamination of these planets since there is a reasonable probability that the conditions on Mars are such that some terrestrial organisms might grow. Carbon compounds, light for photosynthesis and probably water and nitrogen are all available. It is therefore of the greatest importance that space vehicles should not land either accidentally or deliberately on Mars (and possibly also Venus) unless all precautions have been taken to exclude living organisms from them. Otherwise the most challenging of all planetary studies, that of extra-terrestrial life, may be put in jeopardy. The same precautions in regard to the development of complex molecules which have been dealt with in respect of lunar contamination in paragraph iv below apply equally to both Mars and Venus.

(iii) Panspermia Hypothesis The suggestion that moon dust might help in evaluating the hypothesis that dissemination of life in the cosmos occurred by transport of forms of life i in the Cosmic dust must be rejected because solar radiation (in high vacuo) would decompose "biospores" just as it decomposes cosmic dust. The possibilities by which a spore might travel through space inside meteorites involve so many improbabilities that they do not justify special consideration at this stage.

(iv) The development of complex molecules The basic problem concerning the origin of life is how complex molecules (on the earth they are based on carbon) came to be built up and become replicated. It is conceivable that the interior of the moon dust may provide some valuable clues in this direction. It is not beyond the bounds of possibility that some "pre-life" processes may be occurring on the moon and these may be similar or different from those which had taken place on earth. If there are any such processes then the introduction of "foreign" macromolecules from the earth may cause a serious upset in the lunar processes. The earth macromolecules may, under lunar conditions, act as templates and provide new foci for "pre-life" growth. If such events were started indiscriminately all over the moon the pattern might be distorted. It is important to emphasise that living cells are not envisaged for this process and that in this connection a dead bacterium from an aseptic rocket would be as harmful as a live one. The occurence of any such growth reactions is remote and does not justify the imposition of any irksome restrictions on lunar exploration but where reasonably possible it should be borne in mind. A simple precaution against endangering future studies might be to limit the areas of landings on the moon and thereby to localise the effects - if any - of terrestrial templates.

THE ROYAL SOCIETY
11 Clarence Terrace Regent's Park
London N.W.1.
Paddington 3018

IGY/AFM/JME
5 January 1960

Dear Mr. President:

At the second Meeting of COSPAR, The Hague, March, 1959, the Delegate from U.S.A. announced the willingness of the U.S. National Aeronautics and Space Administration to launch complete scientific paylaods in artificial earth satellites, for other countries.

Following this generous offer, United Kingdom scientists have discussed informally with N.A.S.A. bilateral arrangements which would result in scientific payloads designed in the United Kingdom being launched in United States satellites. It is intended that these informal arrangements shall shortly become the subject of a formal agreement between the two Governments concerned. The experiments which it is proposed should be carried in the first satellite of this series are described in the Annex to this letter. These experiments have yet to be discussed in detail with N.A.S.A., and are, of course, subject to changes due to technical considerations.

In accordance with the Purpose and Objectives of the proposed COSPAR CHARTER, we are informing you of this proposed joint United States - United Kingdom arrangement. Comments on scientific aspects of the experiments will be welcomed by the British National Committee on Space Research.

Yours sincerely,

(signed)

H.S.W. Massey
Chairman
British National Committee on Space Research

Professor H.C. van de Hulst,
President Committee on Space Research (COSPAR)
c/o First International Space Science Symposium,
Centre Universitaire Méditerranéen,
Boulevard des Anglais, Nice, France.

ANNEX TO LETTER: IGY/AFM/JME 5 January 1960

A. Ion and Electron Studies by Probes

This experiment makes use of the principles of the Langmuir probe and its extensions (especially by Druyvesteyn) to determine three quantities of fundamental importance.

1. Electron Temperature

A measurement of the ration of the first and second derivatives of the i-v cume of a small electrode leads directly to a value for the electron temperature. Since, at satellite heights most electrons belong to a group in thermal equilibrium with the ambient gas, this temperature provides a direct measure of the kinetic temperature of the gas. The latter quantity has nog hitherto been susceptible to direct measurement, and values obtained from drag data are subject to many uncertainties.

2. Electron Concentration

This ia a by-product of the temperature measurement. It is of great importance above the F-layer maxima. It is felt to be an important aspect of the proposed inclusion of this facility that it will provide a mutual check with Professor Sayer' dielectric measurements.

3. Ion Mass Spectrum

Application of the Druyvesteyn analysis to the screened probe curve can provide the energy spectrum of incoming ionization. Because of the hypersonic velocity of the satellite t is energy spectrum is directly convertible to a mass spectrum. Data on the mass spectrum of the ions in the F-layer is extremely scanty. It is most important for providing an understanding of the F-layer equilibrium.

All the above experiments should oper te over as wide a latitude, altitude and time range as possible.

(R.L.F. Boyd, Department of Physics
University College London)

B. Electron Density Experiment

The plan of this experiment is to use the measurement of the R.F. complex conductivity between two electrodes mounted on the satellite as a means of exploring the local spatial electron density.

At the lowest levels of the ionosphere, as investigated by rockets independent measurement of both real and imaginary parts of the complex conductivity can be used to calculate both electron density and electron collision frequency. At normal satellite altitudes, however, the electron collision frequency will be so low compared with the probing R.F. frequency that the conductivity will be almost wholly imaginary and under these circumstances only electron density can be calculated and not collision frequency.

At very great altitude, in the region of transition from a terrestrial to a solar atmosphere, it is reasonable to suppose that the gas is very nearly completely ionised and so a measurement of electron density should yield information of gas particle density in such regions. This type of information, which is not easy to obtain by other methods, might be useful in understanding the structure of the solar atmosphere and interplanetary gas.

(J. Sayers, Department of Electron
Physics University of Birmingham)

C. Solar Radiantion Studies

The study of the solar X-ray and ultra-violet spectrum is most important in its right. While this is relevant, the proposal to carry it on Scout 1 is primarily concerned with correlating solar behaviour with the proposed ionospheric measurements. Two sets of measurements will be made in the wave length range 8-20 Å and around 1216 Å (Lyman-α). These ranges are dictated partly by technical considerations and partly by solar-atmospheric relations.

In the measurements in the X-ray region a proportional counter and pulse height analyser will provide a somewhat coarse spectrum. Measurements of Lymann-α will be made with nitric oxide ionization chambers.

Provision will be made (by photo-cells) to determine the relevant aspect data.

Three Lyman-α chambers and two X-ray counters are proposed.

(R.L.F. Boyd, Physics Department,
University College London)

D. Cosmic Ray Experiment

The purpose of his experiment is to make accurate measurements of the primary cosmic ray energy spectrum and of the way in which this spectrum changes as a result of modulation by the interplanetary magnetic field. There are at present several alternative models of this field and in order to distinguish between the various possibilities, much more refined data are necessary than those at present available from the observation of secondary cosmic ray intensity variations deep in the atmosphere and fragmentary information from balloon ascents.

In the present experiment it is proposed to investigate the cosmic ray spectrum by using a Cerenkov detector to measure the intensity of heavy nuclei, ($Z > 6$) as a function of latitude. The energy spectrum can then be determined from the known values of the minimum energy which a particle must have in order to penetrate the earth's magnetic field at a given latitude. The advantage of measurements carried out in this way are:

(a) It avoids invalidation of cosmic ray measurement by inadvertant detection of Van Allen particles;

(b) It avoids the introduction of uncertainties by albedo particles scattered back from the atmosphere.

Simple data storage of the kind used in Explorer III will be required.

The detector will sweep through the cosmic ray energy spectrum four times on each circuit giving a virtually continuous check on its variation with time. In addition it is intended at the same time to carry out aeroplane surveys so that the intensity distribution in the atmosphere can be uniquely related to the primary spectrum. It is hoped by this means to obtain a sufficiently accurate relationship between primary spectrum to be determined at any future time simply by means of an aeroplane survey. The proposed experiment is in a sense, an extension of the present programme of cosmic ray work at Imperail College and should provide date of long term value.

(H. Elliot, Physics Department,
Imperial College, London)

REPORT OF WORKING GROUP III
ON DATA AND PUBLICATIONS

This report consists of a summary record of the Working Group meetings and a systematic list of recommendations unanimously adopted by the Working Group.

Many of these recommendations were taken over by the full COSPAR in the form of resolutions. Others were taken over with amendments. The text of the relevant resolutions of the full COSPAR is to be found in the COSPAR report, resolutions [illegible] and 14 - 20.

Attached:

Appendix D 1 : Rapid communications for IGY earth satellite program (A.H. Shapley)

Appendix D 2 : Report of personal discussions of A.P.Mitra with space scientists in the U.S.A. and the U.S.S.R.

ATTENDANCE

Persons attending various sessions of the Working Group included:

(Members) :

A.P. Mitra - Chairman
H. Odishaw
J. Rösch
B.G. Pressey

(Invited) :

A. Frutkin (reporter)
A.A. Blagonravov
A.H. Shapley
R.W. Porter
R.C. Peavey
T. Hatanaka

Working Group III held three meetings during the present sessions of COSPAR, one of them jointly with Working Group I. The Chairman invited Mr. A.H. Shapley, Spokesman of the International World Days Service, to attend the Group's meetings and to submit a report on the operation of the AGIWARN network. This report (Appendix D 1) and appropriate recommendations have been further considered by a special committee of the Working Group. The Working Group records its sincere appreciation for the time and advice so generously given by Mr. Shapley. Mr. Frutkin kindly agreed to serve as its Reporter.

The Chairman placed on the table a report giving the results of his discussion with space scientists of the USA and the USSR, prior to the meetings of this Working Group, on a special trip undertaken at the suggestion of the President of COSPAR (Appendix D 2). The agenda of the Working Group was drawn to discuss the various points raised in these discussions. One of these concerned a suggestion made by the Soviet scientists for COSPAR to support visual observing stations, especially in the Southern hemisphere, where such observing stations are few. The Chairman put this suggestion for consideration to the joint meeting of Working Groups I and III. The Working Groups unanimously recommended this suggestion and a resolution was framed. This has since been approved by the full COSPAR.
COSPAR resolution 5 refers (see report, page 14)

The Working Group also notes, for the sake of continuity in what follows here, that the following recommendation was adopted by COSPAR at its second meeting in The Hague:

"<u>Rockets</u>.

It is recommended that the IGY procedure of preparing a Flight Information Summary Form should be followed as described in Chapter XI of the CSAGI Rockets and Satellites Manual. In addition, it is desirable that every effort should be made to complete analysis of the experimental data and to achieve publication within a year after launch".

Working Group III now offers the following unanimous recommendations:

I. <u>Satellites</u>
(COSPAR resolution 14 refers, page 17)

I.I. <u>Pre-launch information</u>. Where, in the judgement of a launching nation, a future satellite will involve significant changes in customary frequencies, power output, orbital inclination, or observational opportunities, it should announce such changes as far in advance as practicable through SPACEWARN (see below). As a matter of courtesy, the recipients of such advance information should leave its public announcement to the launching nation.

1.2 Launching Information. Within hours after a succesful launching, the scientific community should be informed of this fact through SPACEWARN and by announcement in the press, together with pertinent details.

1.3 Orbital Elements. As an aid to tracking, orbital elements should be distributed periodically by the launching nation via SPACEWARN. The elements to be supplied should include the following or their equivalent, with desirable minimum accuracies as indicated :

(a) the inclination of the plane and the longitude of the node, to an accuracy of 1/10th. degree;

(b) the period of the orbit, to an accuracy of 1/10th. second;

(c) the eccentricity of the orbit accurate to 4 decimal places;

(d) the argument of the perigee, to an accuracy of 1/10th. degree;

(e) the epoch, to an accuracy of 1 second.

The elements should be provided on a current basis as frequently as is required to permit observations based upon the accuracies indicated.

1.4 Precise Orbits. It is recommended that precise orbits which are available some time after the observations have been collected and analysed, be deposited in the World Data Centres.

2. Space Probes (or Cosmic Rockets).
(COSPAR resolution No.15 refers, page 18)

Launching information. Within hours after a successful launching, the scientific community should be informed of this fact through SPACEWARN and by announcement in the press, together with pertinent details.

Recognising that for deep space probes only specialised tracking stations can achieve useful results, and that acquisition data must be available within a very few hours of launching, it is recommended that private arrangements be made between the launching authorities and the specialized tracking stations for the rapid transmission of acquisition data.

3. Communication
(COSPAR resolution 16 refers , page 18, 19, 20)

It is considered that there should be available an international channel for rapid communication of information needed for tracking and other observational purposes, in addition to the channels necessary to and established by national programs. The international channel should handle primarily information of general interest and applicability. It is recommended that the World Days ("AGIWARN") network utilized for this purpose during the IGY continue to serve under the name of the SPACEWARN network. It is recommended that the IWDS-CCU be requested to continue to coordinate these satellite rapid communications and the nations responsible for the Satellite Regional Warning Centers continue to support this phase of their work.

3.1 Outline of SPACEWARN network The communication network recommended to be continued comprises, for purposes of satellite communications, four Satellite Regional Warning Centers (SRWC) for the present as follows:

Western Pacific ..... Kokobunji, Tokyo
Eurasia .... Cosmos, Moscow
Western Europe .... Ionosphere, Darmstadt

Western Hemisphere .. Agiwarn, Washington

In general, satellite information is delivered to the network at AGIWARN or COSMOS; the message is then sent to each of the other 3 SRWC's and then distributed to stations within the region by the respective SRWC, according to the regional plans.

3.2 Launching announcements. It is recommended that plain language launching announcements be sent without delay by the SRWC of origin to the other SRWC's and that distribution within each region proceed immediately in accord with regional plans.

3.3 Current Orbital Elements. It is recommended that current orbital elements, as made available by computing centres, be distributed by the SRWC or origin to the other SRWC's, at a regular time of day, and that distribution within each region be carried out at a regular time of day, in accord with regional plans. This message should be appended to a regular daily solar-geophysical data message whenever convenient.

3.4 Station Predictions. It is considered that current orbital elements with rates of change, such as given in SATOR code, are the most convenient present method for efficiently distributing orbital information for large numbers of tracking and observing stations. At the same time it is recognised that station predictions are valuable if they can be supplied and distributed more promptly than orbital elements. In general, any station predictions provided should go directly from computing centres to the respective station, utilising the SPACEWARN network only under special arrangement.

3.5 Reports of Tracking Observations. In general, tracking observations are sent directly from the tracking station to the computing center of the launching agency, either by telegram or by air-letter, as appropriate. Tracking observations may be sent under special circumstances via SRWCs for forwarding by telegram, if unique or urgent, or by air-letter, as deemed appropriate.

3.6 Special Messages. Launching agencies may provide special information or requests of general interest for distribution over the SPACEWARN network by telegram or air-letter, as appropriate.

3.7 Communication costs. It is understood that any communication costs for interchange among SRWCs are borne by the SRWC of origin of the message. Arrangements regarding the costs of distribution within each region are to be made between the SRWC and the recipient.

3.8 Addresses for Satellite Messages. It is recommended that national members of COSPAR ascertain and communicate to the respective SRWC as to the addresses of centers or stations requiring messages of catagories 3.2, 3.3, 3.4. Such members should also determine what, if any, changes or improvements are necessary to assure effective communications and coverage within their areas, and should make appropriate recommendations to the Chairman of Working Group III who will then engage in appropriate discussions with the IWDS.

3.9 Codes. It is considered that the codes given in IGY Annals, Vol. VII, Part I, Section VI "Rapid Communications for IGY Earth Satellites Program" are adequate for the present. It is recommended that the national members make suggestions for modification of existing codes or proposals for new codes to the Chairman of Working Group III, following in general the procedure established in 3.8.

3.10 Effectiveness of Communications. The IWDS is requested to provide a report on the working of the SPACEWARN

..../6

network at the earliest opportunity, for consideration by the Chairman, and ultimately the Working Group, to take steps to provide improvements.

4. Scientific Information.
COSPAR resolution 17 refers, page 20)

4.I Descriptive Experimental Information. Such information should be sent to COSPAR for distribution to all members of COSPAR within a few weeks after launching and should include:

4.II. Nature of the experiments and objectives.

4.12 Type of instrumentation, spectral response, sensitivity and other information needed by investigators working in the same or related fields.

4.2 Raw Data (Original data, as tapes). Such data should be stored for as long as practicable.

4.3 Reduced (calibrated) Data. Wherever possible, the practice of depositing reduced, calibrated data in the World Data Centers should be encouraged.

4.4. Analyzed Data. Supporting data should be included in the body or appendix of a published research paper, or in interim reports, or, if this is not practicable, should be sent to the World Data Centers in tabulated form.

4.5 Availability of Data. Reference to the availability of all forms of these data (4.2, 4.3, 4.4) should be included in the published research paper.

5. COSPAR Reports
(COSPAR Resolution 18 refers, page 21)

5.I Monthly Bulletin. The Working Group recommends that COSPAR issue a monthly bulletin reporting its activities, the launching of scientific rockets and satellites, and noting special articles or papers as well as other news. An early issue should include a list of satellites and space probes launched to date, together with pertinent summary data. It is proposed that the format be very simple and inexpensive, limited to two or three pages per month. It is further recommended that if necessary part-time editorial assistance be obtained in The Hague. It is anticipated that editorial, printing, and mailing costs should not exceed $2000 per annum.

5.2 Rocket Week Reports. It is recommended that COSPAR issue, under cover, an annual compilation of flight summaries representing the rocket launchings conducted during International Rocket Weeks.

5.3. Consolidated lists of sources. It is proposed that the Chairman of the Working Group solicit from the national members lists of journals in which reports concerned with space research are normally published. It is recommended that COSPAR undertake to publish a consolidated list for distribution to COSPAR members.

6. World Data Centers
(COSPAR resolution 19 refers, page 21)

6.I The Working Group notes that COSPAR, at its second meeting, adopted the following recommendations:

It is recommended that World Data Centres for rockets and satellites be continued to service the archive, bibliographic, and distributive needs of space science, as well as making available modest facilities for visiting scientists. These World Data Centres will be unique in their extensive interdisciplinary coverage and in their great volumes of data. While it is not practicable to store duplications of all raw data in the WDC's, this should be done for reduced and analysed data.

6.2. The Working Group recommends further that each World Data Center prepare and circulate a complete catalogue including published and unpublished papers and data held in the Center and related institutions. Such catalogues should be distributed to COSPAR members and other World Data Centers every six months, covering material received in the previous six months. The semi-annual catalogues should be cumulated every two years.

7. Bibliographies
(COSPAR resolution 20 refers, page 21)

The Working Group recommends that each nation adhering to COSPAR prepare a bibliography of published reports and papers in the space sciences, such bibliography to be appended to its annual report to COSPAR and deposited with all the World Data Centers.

Chairman of Working Group III :

Prof. A.P. MITRA,
National Physical Laboratory,
Hillside Road,
New Delhi 12, India.

~~Enclosure 4.~~

~~For COSPAR~~
~~Working Group III.~~

1/5/60

RAPID COMMUNICATIONS FOR IGY EARTH SATELLITE PROGRAM

1. Summary

In the IGY period and during IGC 1959, the rapid communications arrangements of the World Days Program were made available for handling telegraphic messages concerning Earth Satellites. These kinds of messages have been handled: (a) launching announcements; (b) orbital predictions, and (c) approximate tracking observations. The World Days communication channels (sometimes called the AGIWARN Network) were used for freely distributing information and data supplied by launching agencies or other IGY/IGC participating groups, and were used in addition to the many special rapid communication arrangements of the various tracking networks.

In principle, the satellite messages were handled in the same way as solar, geomagnetic, auroral and ionospheric messages interchanged on a short time basis under the World Days Program: the data telegram is sent by the launching agency, computational center or tracking station to the Regional Warning Center with which it is in contact. The Regional Warning Center then sends these data by telegram to the other three Regional Warning Centers. Then all Regional Warning Centers distribute the data to interested laboratories or agencies within their region. The data are given in synoptic codes, the keys to which appear in the IGY Instruction Manual for World Days and Communication (IGY Annals, Vol. VII, Part I.)

The IGY World Days program is being continued in modified form under the ICSU International World Days Service, with rapid data interchange coordinated by the URSI Central Committee on Ursigrams. The experience of these groups should be of assistance to COSPAR in arranging future international collaboration in Space Science.

2. Brief Description of Rapid Communication Arrangements for World Days Program

The World Days Program called for rapid, world-wide interchange of current solar and geophysical data and for the declaration and promulgation of geophysical "Alerts" and "Special World Intervals" (SWI). The communications arrangements for the data interchange may be called the "AGIWARN Network." The main channel for world-wide distribution of declaration of alerts and SWI is the "WMO Network."

a. "AGIWARN" Network

There are four Regional Warning Centers (RWC), located at radio or geophysical laboratories near Tokyo, Moscow, and Washington, with the fourth shared among three laboratories in Western Europe near Amsterdam, Darmstadt, and Paris. These RWC interchange telegrams at least once daily. The messages are sent through commencial or government channels. By long experience and usage, the transit time for messages has been reduced to two hours or less.

.../2

In addition to the RWC, there are two Associate Regional Warning Centres (ARWC) near Sydney (Australia) and Anchorage (Alaska, U.S.A.). These have direct Contacts with only one or two RWC.

The RWC for the Western Hemisphere near Washington also serves as the "World Warning Agency" and is known as AGIWARN, its cable address.

The schedule of interchange data messages among RWC and ARWC and the content of the messages is coordinated by the International World Days Program; all arrangements within the regions for collection and distribution of messages and data are made by the Regional Warning Center concerned, in some cases through regional committees.

The arrangements within the regions vary widely, depending on the needs of the various laboratories and the communication and other facilities available. In summary, they are as follows:

Western Hemisphere. Collection by telegram and teletype and some telephone; distribution by these same channels (no radio broadcast) with several alternative standard daily messages plus special messages.

Western Europe. Collection mainly by TELEX; distribution by TELEX (Amsterdam, Darmstadt) and also by scheduled radio broadcast (Paris), mostly in standard daily messages.

Eurasia. Collection and distribution by telegram, with some use of meteorological communications facilities.

Western Pacific. Collection by teletype, telephone, and special radio circuits; distribution by scheduled radio broadcast and some teletype, mostly in standard daily messages.

b. Use of "WMO Network"

Once Daily (at 1600 UT) a "Geophysical Alert Message" is delivered by the World Warning Agency (AGIWARN) to the Washington terminus of the meteorological communications network coordinated by the WMO. This is a short message in standard format. It is passed throughout the WMO network and reaches all meteorological stations within less than 6 hours. In principle all other geophysical laboratories and observatories may make arrangements to receive the message from a nearby meteorological station. No solar or geophysical data are circulated through this channel, although the alert indirectly gives some data. The present arrangements allow only a single message of general applicability, initiated at a specific time of day and place.

3. Earth Satellite Messages - General

The AGIWARN network has been available and to a certain extent has been used for circulating information on Earth Satellites during the IGY and IGC 1959. Details of the plan appear in IGY Annals, Vol. VII;

..../3

there have been modifications of a few details since that time. The WMO network has not been used for this purpose on a world-wide scale. The satellite messages have been handled in the same way as solar and geophysical messages, except that they usually have been interchanged among RWC upon receipt rather than on a regular daily schedule, and some messages such as predictions or tracking observations referring to an individual station have been sent only to the RWC concerned rather than to all RWC. In general, the AGIWARN network was used when it was most effective or appropriate; probably the large majority of rapid communications in the Earth Satellite program was done by special communication channels.

4. Launching Announcements

Messages concerning the launchings of all Earth Satellites and Space Probes in the USA-IGY program were received by the Regional Warning Center for the Western Hemisphere. These were promptly forwarded to the other RWC. On two occasions, similar messages were received from the Eurasia RWC concerning launchings in the USSR-IGY program (some of the early USSR launchings took place before the AGIWARN channel was arranged). All such messages were distributed to the Associate RWC and the National Warning Contacts serviced by the Western Hemisphere RWC, as well as to individual laboratories requesting such information. It is to be presumed that each RWC acted similarly with the general plan given in the IGY World Days and Communications instructions, first in the IGY News and in a special third supplement to the Draft Manual, and later in the Manual itself, IGY Annals, Vol. VII, Part I. This called for IGY Participating Committees or individual laboratories to work out with their RWC arrangements for forwarding such messages as they needed.

5. Orbital Predictions

Predictions of the future course of satellites are expressed as (a) "station predictions," applicable to a specified tracking station and a specified passage of the satellite; (b) "sub-satellite points," giving the coordinates and time of passage over one or more points of a terrestrial grid, for example longitude and time of passage over the equator; or (c) orbital elements or the so-called "modified orbital elements," from which the time and aspect for any tracking location can be computed for any passage. It is to be noted that (b) and (c) are of widespread or universal applicability, while (a) is of use only to the particular tracking station concerned.

Data of all these kinds have been produced by computing centers. Various synoptic codes for expressing such predictions economically and conventionally in telegraphic messages have been worked out in association with the RWC and appear in the World Days and Communications Manual, IGY Annals, Vol. VII. Computing centers in the US now send encoded prediction messages to the Western Hemisphere RWC, and these are forwarded to the other RWC for further distribution to requesting

..../4

laboratories and stations. For example, 26 laboratories in the Western Hemisphere receive satellite prediction messages by request. The satellite center in the USSR has sent "station predictions" for at least one station in the Western Hemisphere through the AGIWARN network.

6. Tracking Observations

The AGIWARN network has provided a channel for the prompt reporting of tracking observations to computing centers for the purpose of improving future predictions. Various synoptic codes have been devised by satellite centers in association with RWC and the World Days program and these codes appear in the World Days and Communications Manual. A number of tracking stations or station networks have made use of the AGIWARN communication arrangements in this way. The tracking data are not interchanged among all RWC; in general they are sent by the tracking station headquarters to the nearby RWC, and then to the RWC near the computing center of the launching agency for delivery. In this case the AGIWARN network serves as an international channel for communication from a particular tracking station to a particular computing center, although in principle the data are available to any interested agency.

7. Miscellaneous

In addition to the above, the facilities of the World Days organization have been used for (a) relaying launching announcements from the IGY/IGC National Committee of the launching country to the international IGY offices and, recently, to COSPAR headquarters; (b) distributing other appropriate announcements by IGY/IGC National Committees of launching country such as identifying a launching failure which may have been reported in the Press; and (c) distributing prediction messages by mail where the timeliness of telegrams is unnecessary.

8. Sources of Financial Support

The World Days program both during IGY and subsequently is supported by the participants. There are no international funds except to help in the publication of manuals and codes. If one assumes that the RWC are supported on the basis of their other work, usually radio propagation forecasting, then the extra expenses are principally telegraph and cable costs. These include the cost for sending messages from one RWC to another. Another important cost is the telgraphing of messages from the RWC to the national contact or individual laboratory desiring such service. Such arrangements are made individually within a region. Because of the difficulty in many countries in arranging for message costs to be paid by the recipient of the message, the distribution of satellite launching announcements and orbital predictions in some regions seems to have been less than desirable.

..../5

9. Regional Satellite Program Centers

In the development of rapid communications for the Earth Satellite program, some practical modifications have gradually been made in the communications arrangements. In several regions the satellite traffic has been handled by special satellite communications centers instead of the IWDS Regional Warning Center in order to save time, effort and expense. For example, the satellite messages to and from the Eurasian region have been handled by "COSMOS" instead of "NIZMIR." Similarly the Associate Center in Australia is an address in Canberra for solar-geophysical data and one in Salisbury for satellite messages. In the Western Pacific (Japan) and Western Hemisphere (USA) the same enters now handle both kinds of traffic, while in Western Europe, NERA (Amsterdam) handled satellite messages during IGY; the traffic shifted o Darmstadt at the end of IGY, and very recently the satellite messages from AGIWARN have also been sent to RADSEARCH SLOUGH (U.K.) n a trial basis.

10. Codes

The IGY Instruction Manual for World Days and Communications, IGY Annals,,Vol. VII, lists all codes which had been prepared for transmitting satellite information in economical and effective form. Each code is identified by an introductory code word. These are

Visual Observations:	COSMOS, JAPAA, JAPBB, SATOF, SATUG
Other Observations :	SATAN, SATEP, SATAH, SATEJ
Predictions :	SPUxx, SATID, SATOL, SATUM, SATEC, SATIK, SATAB, SATOR.

Little progress has been made in reducing the number of codes in the code book. Some information is available from a survey taken in 1958. At present, the codes in common use appear to be : COSMOS, SATOF, JAPBB, SATOR, SATEC, SPUxx.

A.H. Shapley

CSAGI Reporter for World Days and Communications,

Spokesman for Steering Committee of ISCU International World Days Service

Member, URSI Central Committee on URSIGRAM

January 5, 1960.

REPORT OF PERSONAL DISCUSSIONS OF A.P. MITRA, WITH SPACE SCIENTISTS IN THE U.S.A. AND THE U.S.S.R.

1. PREFACE

The trip on which this report is based was made at a suggestion by Professor van de Hulst, President of COSPAR, and with support from Dr. Porter, the US Vice-President of COSPAR and Professor Federov, the USSR Vice-President. Professor van de Hulst suggested that I undertake a trip to the USA and the USSR "with the special purpose of talking to the most prominent people who have to decide about data exchange and publication in the realm of space research". It was felt that by so doing, it may be possible to evolve a generally agreed set of principles concerning collection, publication and exchange of space data.

2. ORGANIZATIONS AND SCIENTISTS VISITED

A. IN THE U.S.A.

(1) Space Science Board of the National Academy of Sciences : Dr. Porter, President; Dr. Odishaw, Executive Director; Mr. Peavey, Secretary.

(2) World Data Centre A on rockets and satellites : Mr. Pearman.

(3) National Aeronautics and Space Administration :
 a. Dr. Newell and his colleagues at the HQ.
 b. NASA laboratory at the Naval Research Laboratory.
 c. Theoretical division of NASA.

(4) Dr. L.V. Berkner, President of URSI.

(5) Central Radio Propagation Laboratory, Boulder : Dr. Shapley, member International World Days Service; Ionospheric scientists at CRPL.

(6) World Data Centre on Solar Activity, High Altitude Observatory, Colorado.

B. IN THE U.S.S.R.

(1) Academy of Sciences of the U.S.S.R.: Professor Federov, (past Vice-President of COSPAR); Professor Blagonravov, (present USSR Delegate to COSPAR and Vice-President); Professor Beloussov, (Vice-President of USSR - IGY Committee); Professor Masevitch and others.

(2) World Data Centre B on rockets and satellites : Mr. Nikolai.

..../2

3. RESULTS OF DISCUSSION

Throughout the many discussions, it was apparent that genuine cooperation would be available from the Academies of both countries, and that despite some misunderstanding there is a good deal of flow of space data between the USA and the USSR, and from these countries to many non-launching countries. There was general feeling that the IGY procedures have been useful and should be continued.

3.1 World Data Centres

There are at present three W.D.C.s on rockets and satellites and a new one on Upper Atmosphere will soon be initiated by Japan, so that in the near future, space data will be stored in the following W.D.C.s :

WDC A	-	Washington
WDC B	-	Moscow
WDC C1	-	U.K.
WDC C2	-	Japan

The USA and the USSR have decided to continue the operation of their respective WDCs after the IGC 1959, and the IGY procedures will be followed in regard to the supply of data to individual scientists and organizations. In both centres facilities exist for the use of the data by visiting scientists. It was indicated that payment for reproduction of data may be made in the local currency in the case of WDC B and by UNESCO coupons in the case of WDC A.

Catalogues of data collected in these centres are periodically issued and distributed free of charge. In WDC B, a catalogue has been issued containing a list of all publications received by this centre up to July 1st., 1958. A new catalogue for publications received up to December 1st., 1959 is in course of preparation.

WDC A has, in the past, published a number of valuable reports. A new publication that was suggested and agreed to, will contain a list of all satellites launched so far, with important orbital elements, and a provisional bibliography of space publications.

It is recommended that in future one copy of each such catalogues and WDC publications be sent to the COSPAR Secretariat.

3.2 COMMUNICATION ARRANGEMENTS

Dr. Shapley, IGY Reporter on World Days and a member of IWDS, explained in detail the communication arrangement followed during the IGY and in particular the communication of satellite announcements through AGIWARN. It was felt that the AGIWARN procedure should continue and that COSPAR should make a strong recommendation to that effect.

..../3

3.2 continued.

I have requested Dr. Shapley to attend the meeting of Working Group III and present a report on the AGIWARN system.

It is suggested that COSPAR, on receipt of the announcement of launching of a satellite, immediately transmit this information by airmail to countries adhering to COSPAR, to international and national scientific academies and to Chairmen of Working Groups. This should be supplementary to and not a replacement of the current telegram and broadcast arrangement used by the USA and the USSR.

3.3 PREDICTED ORBITS

NASA is soon going the discontinue its procedure of cabling predictions for individual station. NASA feels that this work entails a considerable amount of routine load on the organization, and that at best it serves a marginal interest. Individual stations may, if they wish to make their own predictions from information of orbital elements, be periodically supplied by NASA directly and through AGIWARN, following the procedure outlined in a report recently issued.

The USSR Academy of Sciences, however, will continue to supply predictions. It feels that if predictions are discontinued, there will be a decrease of space activity in astronomical and radio organizations (including radio astronomical organizations) whose main interest lies in a different field. The Soviets, however, were agreeable also to provide orbital elements to the USA.

It is proposed to discuss this point in the meeting of the Working Group.

3.4 SCIENTIFIC INFORMATION

While there was general agreement on the recommendations of the Ad Hoc Committee Report D on this point (Section 5), the USSR Academy of Science feels that the recommendation 5.224 would serve no useful purpose because it is a normal practice in scientific publication to acknowledge sources of data.

With regard to item 5.12 it is recommended that COSPAR establish direct contacts with W.M.O., I.T.U., U.R.S.I., and I.U.G.G. with a view to arranging proper diffusion and efficient use of data that are likely to have a bearing on the operational services. Pending this, it is recommended that copies of data collected in WDCs that are likely to have a bearing on the operation services, should be sent to the appropriate international Union (e.g. meteorological data to WMO; Ionospheric data to URSI; geodetic data to IUGG, etc.)

Under this arrangement each WDC should send such data to at least two places namely to another WDC and to the appropriate International Union. Early publication of interim reports on the results was emphasised.

3.5 PRE-LAUNCH INFORMATION

The USA will supply pre-launch information for all satellites launched by the NASA. The USSR, however, feels that for her satellites this is not necessary since the transmission characterises and the orbital inclination of the Sputniks have remained the same.

It was mentioned that it is not the policy of the USSR to announce flights before they are successfully launched. However, if in future, any changes occur in the transmitter frequency or in the inclination of the orbit, such changes will be announced in advance.

3.6 DISCOVERER SATELLITES

The USSR Academy of Sciences complained that no information was made available to the Russian scientists on the orbits of the Discoverer satellites, which, because of their polar orbits, were of particular interest to the Soviets. The American scientists have pointed out that Discoverer satellites were launched by the Department of Defense of the USA and were not part of the US programme of the IGY.

3.7 COSPAR PUBLICATIONS

It was felt desirable for COSPAR to undertake several publications intended,

a) to post the COSPAR adhering countries on the activities of COSPAR and on the progress of work on rockets and satellites;
b) to compile on appropriate occasions materials on the same subject or on related subjects arising from observations of rockets and satellites. Publications under category (b) may include, for example, the preparation of a special COSPAR volume containing Nice Papers.

The COSPAR may wish to consider undertaking the following publications:

CATEGORY A

COSPAR report
To be issued periodically (perhaps quaterly) and include

a) Activities of COSPAR and its working groups,
b) Quaterly review of satellites in orbit, announcements of

of satellites launched during the period, flight summaries of rockets.

c) National Reports
d) Bibliographies
e) Reproduction of special articles, such as those published by the USSR in Pravda, and by the USA in IGY News Bulletin.

CATEGORY B

1. "ROCKET WEEK" REPORT

This may be issued in two or more parts. The first part will contain / flight summaries of all rockets flown during this /only period all over the world. The second and subsequent parts, if any, will contain results obtained from such flights.

The USSR Academy of Science mentioned that since at the time of the Rocket Week the USSR has not joined COSPAR, it did not participate in this programme. However, on request the USSR agreed to contribute flight summaries of rockets that may have been flown during this period in the Soviet Union.

2. NICE SYMPOSIUM PAPERS

It was felt extremely desirable that COSPAR undertake the work of collection, editing and publication of the papers to be presented at the First International Space Science Symposium at Nice. It would also be desirable to incorporate at least parts of the discussions that will ensue presentation of papers.

3. OUTER IONOSPHERE

A special publication on "Outer Ionosphere" may be issued. It is understood that this subject has been included as a topic of discussion at the next General Assembly of the URSI. A joint URSI-COSPAR report on the subject may be published after the Assembly.

APPENDIX E

C O S P A R

Report of Finance Committee

The Finance Committee held two meetings and reports as follows :-

I.- Support from Member Countries

The Finance Committee recommends that the President of COSPAR should seek support from member countries, taking into account the following points :

(I) Following the appropriate section of the Charter of COSPAR, the President of COSPAR is making this appeal on behalf of the Finance Committee.

(2) The contributions which are being asked for are to be yearly contributions for the five years I960-64. There may be small adjustments each year and the whole position will be reviewed in I963.

(3) It is proposed that there should be 3 categories of contribution, namely :

a) for Satellite Launching Countries	± $I3 000 p.a.
b) for Rocket Launching Countries	± $ 4 000 p.a.
c) for Countries engaged in tracking and / or supporting research	± $ I 000 p.a.

(4) Although contributions are stated in U.S.Dollars, this is merely for the purpose of convenience. Subject to the making of arrangements with the Treasurer of ICSU, contributions may be paid in national currencies.

(5) The COSPAR is well aware of the "hidden" contributions of certain countries (e.g. the travel expenses of certain delegates, and the services of the Officers who, although very busy with their normal duties, are able to give of their time to COSPAR) and is very grateful for these. Should countries wish to continue to render additional support to COSPAR in this manner, it will be much appreciated.

(6) The following papers should be appended :-

a) a summary report of the major organisational work done by COSPAR in I959

b) a financial statement in respect of the period of I4 months ended 3I December, I959

c) the approved budget for I960 - the fiscal year being, in future, the calendar year.

COSPAR BUDGET FOR I960

II.-

INCOME

(a) From 2 Satellite Launching Countries averaging $ I3 000 each		26 000
(b) From 5 Rocket Launching Countries averaging $ 4 000 each		20 000
(c) From (say) I4 Countries engaged in tracking and/or supporting research averaging $ I 000 each		I4 000
		60 000

EXPENDITURE

Meetings

COSPAR Meeting, Nice, January	I0 000	
Organisational Expenses in connection with the Ist. International Space Science Symposium	I 000	
Meeting of the Bureau, I960	I 500	
Meeting of the Executive Council, I960	3 500	
Representation of COSPAR at other scientific meetings	2 500	
		I8 500

Working Groups

The following expenses are to be met out of the amount available to each Working Group :

a) Travel or Small Meetings - as authorised by the Chairman
b) Full Meetings
c) Secretarial Expenses

The amount available to each Working Group is as follows :

Working Group I	5 000	
" " II	9 000	
" " III	4 000	
New Working Groups which may be formed	2 500	
		20 500
C/F		39 000

COSPAR BUDGET FOR I960

II.-

EXPENDITURE (continued)

		B/F	39 000
Secrétariat			
Installation costs in new office		2 000	
Rent, etc.		I 500	
Sundry Office Expenses (Postage, stationery, telephone, etc.)		2 000	
Secretarial Assistance to Working Groups		I 000	
Salaries :			
Administrative Secretary	3 200		
Secretary	I 400		
Typist	I 000		
Social Security etc.	800		
Provision for possible increase in staff and/or salaries during year	4 000		
		I0 400	
Cost of Travel for Secretariat and Bureau		I 500	
Publications		500	
			I8 900
Dues to ICSU			
3 ½ % of $ 60 000			2 I00
			60 000

COSPAR

General Report on the Financial Position

as at 31 January 1960

Period up to 31 December 1959

Following the establishment of COSPAR at the London meeting in November, 1958, a special appeal was made by the President of ICSU, Sir Rudolph Peters, to the 7 Permanent Members of COSPAR, under the provisional charter, inviting their immediate financial support in order that the wor ing of the Committee could proceed.

The response to this appeal during 1959 produced an income to COSPAR of $35,060 from the following sources:-

Canada	$ 5,000
France	5,060
Japan	5,000
U K.	5,000
U.S.A.	15,000
	$ 35,060

In the period from its inception up to 31 December 1959, COSPAR held two full meetings (London, November 1958; The Hague, March 1959) and two further meetings of the Executive Committee (Paris, May 1959); Amsterdam, November 1959) at a total cost of approximately $8,800.

In addition, COSPAR established a Secretariat in The Hague which incurred expenditure of approximately $7,500 up to 31 December 1959. There must be added to this sum the charge of 3.5% which ICSU makes on all funds handled on behalf of Special Committees. This amounts to approximately $1,200.

As an important part of its work during 1959, COSPAR decided to assist the financing of a joint observer with IAU and URSI at the International Telecommunications Conference which was held in Geneva. As

.../2

its share of the total expenses involved in this, COSPAR paid approximately $1,100.

The Income and Expenditure account of COSPAR from its inception up to 31 December 1959 is attached a. Annex A to this report, and from that document it will be seen that COSPAR had in hand approximately $16,600 at 1 January 1960.

At the invitation of the President of COSPAR, the Chairman of Working Group III, Dr. A.P. Mitra of New Delhi, undertook an extensive tour in the months of December 1959 and January 1960 with the aim of coördinating the work of his Working Group. COSPAR undertook to pay the expenses of this journey and of Dr. Mitra's attendance at the Nice meeting, and these come to approximately $2,850.

First International Space Science Symposium and COSPAR Meeting, Nice, January, 1960.

Although the final expenses of the recent meeting of COSPAR which was held at Nice, together with the First International Space Science Symposium, are not yet available, it is possible at this stage to say that COSPAR has been involved in expenditure of approximately $15,250. The Travel and Subsistence expenses of national delegates came to approximately $2,400, and of other delegates (including members of Working Groups) to approximately $7,300.

To this sum must be added the expenses of organisation in respect of both the meeting and the Symposium, which fell to be paid by COSPAR, and these amount to some $2,700.

All these expenses incurred in January 1960 are summed up in the following table:

Nice Meetings - Travel and Subsistence of National Delegates	$ 2,400
- " " " of other Delegates	7,300
Organisation and other Expenses	2,700
	$12,400
Journey of Dr.A.P.Mitra, Chairman of Working Group III	2,850
	$15,250

..../3

The Present Situation.

From the figures so far mentioned in this report, it will be seen that COSPAR had only some $1,350 left at its credit with which to carry on in 1960. COSPAR is already committed to the continued running of a Secretariat which, it is estimated, will cost $1,600 per month, so that, on this basis, the funds of COSPAR are already exhausted.

ICSU Accountant
A.S. MacLennan

8th, February, 1960

COMMITTEE ON SPACE RESEARCH

ESTABLISHED BY
THE INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

REPORTS ON NATIONAL ACTIVITIES

presented at
The Third COSPAR Meeting
Nice, France, January 8 - 16, 1960

Contents :

REPORT OF ACTIVITIES
IN THE ARGENTINE

Presented by H.R. Ciancaglini

In our country there were investigators working in subjects related with spatial research, but not connected between them. It was necessary to join the efforts of those groups in order to coordinate and improve the efficiecy of their labour.

The Argentine National Scientific and Technical Research Council (CNICT), aware of the increasing importance of the Space Research created a committee for that purpose, in the middle of last year.

Under the auspices of the C.N.I.C.T., two meetings have been held, in June and November of last year (1959). The papers dealt with subjects related to the science of space. In the last meeting a plan for future activities was also developed.

The principal immediate activity will be the study of every information, which will be centralised in a special library. Many activities of specialists, which are not intended specifically for the science of space, may be useful directly or though minor modifications to that purpose. Bi-annual meetings will be held in order to coodinate both information and schedules.

REPORT TO COSPAR OF THE AUSTRALIAN NATIONAL COMMITTEE ON SPACE RESEARCH

presented by L.G.H. Huxley

The chief matters to report upon since the meeting of COSPAR in March 1959 are :

(a) the work of the Satellite Tracking Station at Woomera,

and (b) the formation by the Australian Academy of Science of a National Committee on Space Research.

(a) The Satellite Tracking Station is treated at Woomera and is maintained as a permanent section of the Weapons Research Establishment of the Department of Supply. It has been extremely active and has successfully recorded much information on satellites.

It is proposed to develop the work of the Station by farther installation of more accurate and flexible equipment.

Details of the work of the Station and plans for its extension are given in Appendix A.

(b) The Australian National Committee on Space Research

The membership of the Committee is as follows :-

Dr.D.F.Martyn (chairman); Dr.L.G.H.Huxley (Convenor); Mr. W.A.S.Batement; Mr.R.W.Boswell; Dr.G.H.Munro; Dr.J.L.Pawsey; Professor N.C.Webster; Mr.H.A.Wills; Professor Bast Bok; Dr.C.H.Priestley; Dr.V.D.Hopper; Dr.M.W.Woods.

The Committee has met twice in order to consider a programme of Space Research and has submitted recently proposals to the Australian Government with a request for financial support, and the approval of the Government is awaited.

The specific proposals are given in Appendix B.

APPENDIX A

I. The facilities at Woomera for tracking and recording space vehicles may be conveniently divided into existing and proposed. Para 2 below deals with existing satellite tracking equipment and Para 3 with the probe and additional satellite tracking equipment which is likely to be installed in the future. Para 4 gives achievements to date and Para 5 ancillary studies.

2. The existing equipment is as follows :-

BAKER-NUNN CAMERA : A specially designed 30 inch aperture F/I Schmidt Camera with 30° x 5° field, known as the Baker-Nunn Camera, is operated for the Smithsonian Astrophysical Observatory. This records the apparent positions of satellites with respect to the stellar background during favourable twilight periods i.e. when the atmosphere is in the earth's shadow and the satellite is illuminated by sunlight. The angular accuracy is I-2 seconds of arc, the timing accuracy is a few milliseconds with respect to U.T. The limit of recording is approximately I3th Stellar magnitude at satellite angular rate.

MINITRACK : A phase comparison system of tracking at radio wave-lengths known as Minitrack is operated for the National Aeronautics and Space Administration. The equipment is designed primarily for I08 megacycles which is the oscillator frequency used in the majority of U.S. satellites. The resolution of the system is 3.6 seconds of arc at I08 megs, although the over-all accuracy is limited by uncertainties in ionospheric deviation to about 20 seconds of arc under quiet nightime conditions and to 2-3 minutes of arc during the day. At this frequency high gain aerials give an effective beam of II0 degrees in the meridian plane by I0 degrees E-W. For 40 megacycles operation with Russian satellites, single dipoles are used together with frequency mixing at the receiver front end to permit the recording equipment to function normally with 40 megacycle reception. The system includes time measurement to an accuracy of a few milliseconds with respect to WWV as received.

I08 MEG. TELEMETRY : Two receiving equipments and one seven channel Magnetic tape recording unit are installed for I08 megacycle work. The system includes transmitters for interrogating U.S. satellites fitted with an internal telemetry storage system. A high gain aerial of beam II0 degrees N-S by I0 degrees E-W is employed on a single axis (N-S) tracking mount.

TELEMETRY ON RUSSIAN SATELLITES : Two receivers and associated units are available for telemetry reception at 40 and 20 megacycles. The equipment includes Doppler Shift detection facilities, and recording of the detected signal is done on the seven channel magnetic tape recorder referred to in para 3.3 above. The aerial system is a single dipole.

TELEMETRY ON U.S. "IGY HEAVY" SATELLITE (EXPLORER VII) : A special antenna of about 8db gain in the frequency range II to 60 megacycles has been provided by NASA for telemetry reception at 20 megacycles. The antenna has a beam of approximately 90 degrees in elevation and 60 degrees in aximuth, and can be rotated through 360 degrees in azimuth. Receivers and associated detection and magnetic tape recording equipment are also installed. Primarily intended for the U.S. "IGY Heavy" satellite, this equipment could also be utilized for telemetry reception from Russian satellites.

PROTON PRECESSION MAGNETOMETER : Although not an instrument for satellite tracking, this device is associated with the Vanguard Magnetometer Satellite. The magnetometer automatically records values for the earth's magnetic field vector every three minutes. It is intended to provide data on the earth's field at the earth's surface, while the magnetic field at the satellite is being measured. The purpose of the experiment is to establish the presence, or otherwise, of extra-terrestrial ring currents during magnetic storms.

3. The equipment which will probably be installed is as follows :-

MINITRACK : An advanced form of Minitrack system is being developed in the U.S. operating at I36-I37 megacycles. Improved angular accuracy is sought by the use of aerials spacings of 800 ft, compared with 500 ft in the existing system. The layout of the aerial system is more elaborate, permitting the choice of a N-S fence as at present, or an E-W fence. The read-out system is also more advanced, being suitable for direct insertion into a Teletype network with very little processing by Station personnel.

DOPPLER : A system for obtaining precise doppler data for orbits of satellites operating on frequencies other than the regular Minitrack frequencies will be installed.

TELEMETRY AND SPACE PROBE TRACKING : It is intended that a primary Space Tracking Station with between one or more large tracking antennas will be set up at Woomera in conjunction with NASA. The antenna will be more or less general purpose, handling a large number of frequencies and being able to transmit or receive. They will have auto-follow, programme tracking or manual tracking capabilities. The first and probably the largest to be installed will be an 85 ft dish. The frequencies planned for the 85 ft dish are, in the immediate phase, 20 and 40, I08, 225-260, 960, I435-I535, 2200-2300 megacycles. In the future phase the following megacycle frequency bands will be used I700-I725, I825-I850, 2275-2300.

RADAR TRACKING : It is also proposed that existing precision radars installed at Woomera and new radars located near Perth will be used in conjunction with telemetry and other ancillary installations for special satellite tracking programmes.

4. The general efficiency of the Station in satellite tracking can be inferred from a recent press release, as follows :

BAKER-NUNN CAMERA : Since its installation at Woomera (in March, I958) this camera has achieved a consistently higher success rate than any of the other II similar stations -

which means that it has achieved a greater percentage of possible sightings.

The first photographs of five of the American satellites were obtained at Woomera, viz.,

(i) ATLAS (I958 Zeta) was photographed during the first evening after launch.

(ii) VANGUARD II (I959 Alpha) was photographed within twenty-four hours of launch.

(iii) EXPLORER VI (I959 Delta, called Paddle Wheel) was first photographed at Woomera even though its distance from the earth was then in excess of 5,000 miles.

(iv) EXPLORER VII (I959 Iota, called IGY Heavy) was photographed on its second orbit - only 2 hours 50 minutes after launch.

(v) DISCOVERER VII (I959 Kappa). This was the only photograph of this satellite taken throughout the world.

The Woomera Station also holds two important distance records, viz.,

(i) The Grape Fruit satellite (VANGUARD I) - which is only 6 inches in diameter - was photographed at a distance of 2,500 miles; this is a considerably greater range than has been achieved by any other camera on this satellite and demonstrates a capability one magnitude greater than the designer of the camera intended.

(ii) The Paddle Wheel satellite was photographed at a distance of I4,500 miles, which is greatly in excess of the range achieved elsewhere.

MINITRACK : The staff at Woomera have been congratulated by the National Aeronautics and Space Administration (NASA) on having the "best maintained" of the IO Minitrack installations. The Station has retained its accuracy to within 20 seconds of arc throughout the 2I months of its operation.

The Woomera Minitrack station obtained the first passage of :

(i) EXPLORER IV (I958 Epsilon) on its first orbit.

(ii) EXPLORER VI (Paddle Wheel) on its first orbit.

(iii) EXPLORER VII (IGY Heavy) also on its second orbit.

5. In addition to satellite data gathering, the S.T.S., Woomera, is engaged on various upper atmosphere studies, for some of which the satellite tracking equipment can be utilized. Some notes are given below :-

IONOSPHERE STRUCTURE : The refraction of radio waves at I08 megacycles can be measured by comparing angular directions to satellites and missiles measured on the Minitrack system with directions measured optically with precision equipment such as the Baker-Nunn. The electron densities obtained from this can be compared with information from an ionospheric sounder which is also operated by S.T.S. Further data can be obtained by measuring the extent of Faraday rotation of the plane of polarization of satellite and missile aerial systems. In this way it is hoped to make a fairly detailed study of the ionosphere at various times and, in particular, to gather data on the area above the F2 maximum.

Simultaneous Minitrack and Baker-Nunn recordings have been made on some I5 satellites and a long Minitrack follow on a missile flight with some optical follow has been obtained. The considerable analysis work required to fully reduce this data is being progressed slowly.

A number of signal strength recordings with various ground aerial arrangements have been made and studied, and it is now possible to clearly distinguish between fades due to satellite rotation and Faraday effect for each satellite. This method of measuring integrated electron densities appears to be very powerful, particularly with satellites radiating at 20 megacycles.

AIRGLOW : Some study will be made in the near future of infra-red radiation in the night airglow both from equipment located on the ground and carried in a Long Tom rocket. The radiation to be studied in the first instance is that associated with the OH radiation at heights of the order of 80 kilometres. This project has been accepted as an item on the ANCOSPAR programme.

MISSILE GLOWS ETC.: Atmospheric phenomena associated with the flight of high altitude missiles could yield valuable data on the upper atmosphere. Spectoscopic data has been obtained on the re-entry of one such missile into the earth's atmosphere. It is planned to continue re-entry study with improved equipment and to develop equipment for examining other glow effects which occur elsewhere in flight.

APPENDIX B

Recommended Research Projects.

INTRODUCTION

The Australian National Committee on Space Research reviewed a number of specific proposals which it had received both from Government organisations and from Universities in response to an invitation.

Of the fifteen proposals submitted, the Committee decided to sponsor eight which were selected according to the following criteria :

I. The project is new in conception and of considerable scientific value ;

or

2. it comprises an improved technique or new method of conducting measurements already made or being made ;

or

3. the project derives special significance from Australia's geographical position, in that it provides Southern Hemisphere data complementary to that available from the Northern Hemisphere.

RECOMMENDED PROJECTS

Satellite Vehicle

Dr.D.F. Martyn (C.S.I.R.O. Upper Atmosphere Section, Camden, N.S.W.) proposes to investigate, above the atmosphere, the low frequency radio emissions that occur in bursts in the band of frequencies 2 - 40 kc/s and are normally associated with high frequency radio bursts from the sun and disturbances in the geomagnetic field.

These low frequency emissions appear to be caused by the interaction between the outer atmosphere and the streams of particles that cause aurorae.

Acting upon the offer of the U.S.Aeronautical and Space Administration it is proposed to recommend to NASA that space be allocated in the U.S. satellite vehicle Scout.

Rocket Vehicles

The projects are grouped according to compatibility, that is to say, according as two experiments may be conducted with the same rocket without mutual interference.

First Group

Dr.E.B.Armstrong (Satellite Tracking Station, Woomera) proposes to investigate in detail the powerful infra-red emission from the hydroxyl radical OH by means of photometers sensitive to the infra-red carried in rockets. The range of heights of interest are 30 to 95 kilometres and the launchings would be made at night, in the first instance.

Professor L.G.H.Huxley (Department of Physics - University of Adelaide) proposes to study winds at high altitudes. At present quarterly observations of winds are made by means of balloons up to heights of 40 kilometres. Monthly measurements of winds are also made at the University of Adelaide by means of radio reflections from meteor trails between the heights of 70 and 100 kilometres. There is need to obtain information about winds in the intervening region in the range of heights 40-70 kilometres.

It is proposed to measure winds from the drift of clouds of "window" ejected from rockets and tracked from the ground. Knowledge of atmospheric circulation up to a height of 100 kilometres in these latitudes would then be complete.

It is anticipated that 16 rocket firings (Long Tom or Skylark) at the rate of one a month would be necessary.

Second Group

Dr.J.I.Pawsey (C.S.I.R.O. Radio Physics Laboratory, Sydney) proposes to investigate the nature of the layer of dust seen at a height of 80 kilometres and known as noctiluoent cloud. It is not known whether this "cloud" comprises ice-crystals condensed on meteoric dust or whether it is actually dust of meteoric origin.

It is proposed to eject water and silver iodide into this region and to observe whether or not the cloud is intensified.

Professor H.C.Webster (Department of Physics - University of Queensland) wishes to investigate the phenomenon of "sporadic E-ionisation" in the lower ionosphere by means of radio waves emitted by a transmitter in a rocket. It is suggested that these measurements be made from the rockets to be used in the preceding project.

Third Project (separate)

Dr.D.F.Martyn wishes also to investigate the low frequency emissions (mentioned above) by means of rocket borne receivers.

These experiments should be made from rockets on call, the firings to be co-ordinated with the occurrence of solar flares.

Four rocket firings are suggested.

Balloon Observations

Dr. V.D. Hopper (Department of Physics, University of Melbourne) wishes to study atmospheric composition, winds and cosmic rays by means of balloons and

Dr. G. Fenton (Department of Physics, University of Tasmania) wishes to investigate cosmic rays.

Moonwatch

There are five Moonwatch Groups (Adelaide, Melbourne, Perth, Sydney and Townsville) operating with great efficiency and providing useful information supplementary to that obtained by the Satellite Tracking Centre at Woomera.

Outstanding achievements have been :-

I. Sydney - First World wide observation of 1957 α

2. Perth - " " " " " 1957 β

3. Perth - November 1957 - 14 out of 18 world wide observations of 1957 β

4. Adelaide - Last observation of 1957 α

5. Adelaide - World wide search for 1958 β, during April and May 1958 resulted in two sightings - one in Adelaide.

6. Adelaide and Perth - Among the few Moonwatch teams to sight 1958 δ during its last three days.

7. Adelaide - Special commendation from the Smithsonian Astrophysical Observatory for an observation of 1958 ξ on I/I/59.

8. Adelaide - World wide search for 1958 ξ in June 1959 (lost) - Found by Adelaide and stations in Japan.

The following is a quotation from a letter from the U.S. Air Force Agency, Space Track to the Adelaide Group :

> "In view of the scarcity of good observations from the Southern Hemisphere your contribution in observing Satellites is extremely valuable".

It is highly desirable that this work be encouraged and the groups kept alive.

REPORT ON BELGIAN ACTIVITIES

Presented by M. Nicolet

In June 1959, a National Space Research Committee was created by the Royal Academies of Sciences of Belgium in order, among other things, to represent the Academies in COSPAR.

This Committee is in close relation with the National Center of Space Research, grouping representatives of the Scientific Belgian Universities and Institutions. Its address is : Centre National des Recherches de l'Espace (CNRE), 3 avenue Circulaire, Brussels 18.

The object of CNRE is to develop research dealing with space. At present, the programme includes visual observation of satellites, theoretical problem of orbits and study of upper atmosphere structure. The first results obtained on the atmosphere's structure will be presented at the symposium. In the immediate future, studies will be effected on problems of physics and chemistry of atmospheres. The future programme will depend on possibilities provided to the Center.

REPORT OF CANADIAN ACTIVITIES

1. The Canadian National Committee

Early in 1959 the National Research Council of Canada formed an "Associate Committee on Space Research". This Committee is organised along parallel lines to associate committees in other scientific disciplines. These committees are national in character and form the connecting link between international unions or ICSU special committees and the activities in that discipline in Canada. The committee is, therefore, the Canadian National Committee on Space Research and coordinates non-defence space activities in Canada.

The membership in the Committee is as follows:

IRMAN

Dr. D.C. Rose	-	National Research Council

BERS

Dr. J. Auer	-	National Research Council (representing medical interests
Mr. C.M. Brant	-	Department of Transport (Telecommunications Division)
Dr. J.H. Chapman	-	Defence Research Board
Mr. R.F. Chinnick	-	Defence Research Board
Mr. J.W. Cox	-	Defence Research Board
Dr. P.A. Forsyth	-	University of Saskatchewan
Professor C. Fremont	-	Laval University
Dr. G.M. Griffiths	-	University of British Columbia
Dr. A.D. MacDonald	-	Dalhousie University
Mr. J.A. McCordick	-	Department of External Affairs
Mr. P.D. McTaggart-Cowan	-	Department of Transport (Meteorology Division)
Dr. D.W.R. McKinley	-	National Research Council
Dr. A.D. Misener	-	University of Western Ontario
Dr. G.N. Patterson	-	University of Toronto
Mr. M.M. Thompson	-	Dominion Observatory
Mr. F.R. Thurston	-	National Aeronautical Est.
Dr. B.G. Wilson	-	University of Alberta
Dr. C. Winkler	-	McGill University

RETARY

Mr. B.D. Leddy	-	National Research Council

An executive and coordinating committee has been formed consisting of :-

Dr. D.C. Rose	-	Chairman of the Associate Commit
Dr. J.H. Chapman		
Mr. J.W. Cox		
Dr. D.W.R. McKinley		
Mr. B.D. Leddy	-	Secretary of the Committee

II. The Fort Churchill Rocket Launching Facility

The rocket launching facility at Fort Churchill was establised as an IGY activity by the United States on the invitation of the Canadian Government. Though the facility was financed by the United States and United States personnel operated the facility the Canadian contribution was considerable in that it was established at a defence base where housing and messing of personnel were already available. Laboratory space was provided by the Canadian Defence Research Board, the required meteorological services were partly provided by the Department of Transport and aurora and ionosphere observations supporting the rocket work were supplied by Canadian teams. The rocket launching facility operated under the jurisdiction of the Canadian Commanding Officer at Fort Chruchill. Although the contribution of the United States authorities was great and, in fact, made the much smaller Canadian rocket program possible the project was considered as a joint effort. Canadian research workers in this field appreciate the advantages in experience and opportunity given us by our United States colleagues in establishing this facility in Northern Canada.

At the close of the IGY the agreement between the Canadian and United States Governments terminated and the launching facility was closed for several months. When the post-IGY program was prepared and the formation of NASA was completed a long-term program was planned. This is in hand at present. It involves the joint use of the Fort Churchill launching facility by United States and Canadian scientific teams. It is anticipated that the United States program at Fort Churchill will be considerably larger than Canadian activities for some time.

The launching facility at Fort Churchill is rather unique in that it was designed for scientific purposes, only a few launchings have been carried out in the area having a defence objective. The facility includes two launching towers, one for liquid fuel rockets 15 inches in diameter particularly designed for launching of the Aerobee type of rocket. The second is a launching rail suitable for smaller rockets of the Nik-Cajun type. In addition, a simple rail launcher was built during 1959 by the Canadian Armament Research and Development Establishment for launching at elevation angles up to about 70° a series of 17 inch solid fuel rockets designed as propellant test vehicles (P.T.V.).

The facility is equipped with preparation buildings for the two vertical launchers and connecting corridors. A Doppler velocity and position indicator (DOVAP) is included with appropriate ground stations in an array up to about 10 miles from the launching site. A VHF communication system is installed connecting all stations. A radar tracking system is used, a beacon being carried in the rocket, for range safety control. Telemetering systems for recording signals from the rocket are available.

III. I.G.Y. Rocket Firings

Approximately 120 rockets were launched at Fort Churchill during the pre-IGY and IGY period. The objectives covered measurements on pressure, temperature, density, winds, magnetic field, cosmic rays, various types of radiation and electron density in the ionosphere.

..../3

III. cont.

Canadian scientists took some part in the whole program and the instruments in two IGY Nike-Cajun rockets were completely built by Canadian scientists at the Canadian Armament Research and Development Establishment. These were launched successfully in the autumn of 1958. The objectives will be discussed in Section V of this report.

IV. Post-IGY Launchings

A continued program of launchings for scientific purposes has been arranged during the latter months of 1959. Plans are in hand for launchings during 1960 and for an indefinite period thereafter.

V. Canadian IGY Launchings at Churchill

The two rockets launched at Churchill carrying Canadian built instruments were designed for studies in the sodium layer, and of radiation in certain infra-red bands in the upper atmosphere. The instruments were carried in Nike-Cajun rockets. They included photometers of spectral sensitivity selected to detect sodium and infra-red detectors sensitive to selected bands in the OH emission spectrum. Valuable data were obtained on the height of the sodium layer and the height at which the OH emissions were strong. The details will not be included in this report since they are being presented in a paper by Mr. R.F. Chinnick at the symposium being held at the time of this meeting of COSPAR.

VI. Canadian Rocket Experiments during 1959

(a) Ionosophere and Cosmic Ray Measurements

Two Aerobee-Hi rockets were launched at Fort Churchill in September 1959 containing Canadian experiments. The primary experiment in each rocket was for the measurement of electron densities in the absorbing layers in the lower ionosphere, using the well known two frequency technique. Cosmic ray measuring instruments were included and auxiliary instruments included an aspect indicator based on the direction of the sun and a magnetometer. One of the rocketswas launched successfully and good data were obtained up to over 200 Km. The second rocket failed after a few seconds of flight. The details of these experiments will be presented by Dr. J.H. Chapman at this symposium.

(b) Propellent Test Vehicle (PTV)

Research on propellants for large rockets has been carried out for some time at the Canadian Armament Research and Development Establishment. Four propellant test vehicles (PTV) were launched at Fort Churchill in September 1959. Since investigations into rockets and propulsion are not in the terms of reference of COSPAR no details will be presented here except to say that modifications of this vehicle give promise of being a very useful and economical rocket for scientific purposes capable of carrying a payload of 100 Kg to a height of 250 Km.

..../4

VII. The Canadian Satellite Experiment

Arrangements have been in hand for some time for the construction of instruments in Canada by our Defence Research Telecommunications Establishment to be launched in a polar orbit using a United States satellite launching rocket sometime in 1961. The experiment is in effect an upside down vertical incidence ionosphere sounder (topside sounder). Pulses from the satellite will be transmitted and the return echo from the top of the ionosphere will be observed. Preliminary experiments involve the measurements of cosmic noise in the region of 3 Mc/sec above the ionosphere. Equipment to do this has already been prepared and may be demonstrated at the symposium held at the time of this meeting. Dr. J.H. Chapman is presenting some details of this experiment at the symposium.

VIII. Future Plans

It is anticipated that the growth of space research in Canada will be slow. Our United States colleagues will continue to operate the launching facility at Fort Churchill for the next few years and are planning for the launching of a number of rockets from these during 1960. We will contain the close cooperation that was carried out during the IGY.

During the year 1960-61 we expect to launch a few rockets from Fort Churchill in a Canadian program but using the joint range facilities. The Canadian program will probably include between five and ten rockets some of which will be the 17 inch solid fuel rockets mentioned above. These will carry instruments to measure electron density, atmospheric density, magnetic field and cosmic rays.

IX. Satellite Tracking

A "Minitrack" satellite tracking station is being constructed near St. John's, Newfoundland, that is, near the most easterly of the Canadian coast. This will form one of the networks of Minitrack stations operated by NASA. The station will be established by NASA but its operation will be a Canadian project.

REPORT ON FRENCH ACTIVITIES

Presented by P. Muller

The French contribution deals with rockets and satellites.

1. ROCKETS

A series of 3 rockets, Veronique, have been successfully launched at Colomb-Béchar in March 1959; two of them have ejected a cloud of sodium; the first reached an altitude of 127 km, the second reached an altitude of 180 km. Temperature, density and wind directions at high altitude were measured.

The Office National d'Etudes et de Recherches Aéronautiques has directed the studies on the realisation of rockets and vehicles of space research for exploration up to 1.000 km, which could eventually direct the launching of satellites. An experimental missile was used for the study of radioactive artificial aerosols concentrations at high altitude. This was done in collaboration with the Commissariat à l'Energie Atomique.

The 1960 programme includes the launching of 20 rockets Veronique in three series: six in February (ejection of Sodium and Potassium), four in June (2 Sodium and 2 of chemical explosion), ten in December, having two programmes: a.) the width of the Lyman and the magnetic field by magnetic resonance of Caesium, b.) diffuse light of the sky.

2. SATELLITES

The system of French stations includes: a centre at Meudon, equipped since a few months with a teletype, and since a few days with an IBM 650 machine; posts in some Observatories and some twenty stations of the Météorologie Nationale. As it has been announced in The Hague, ten of these stations situated in the overseas territories, have joined those already operating in France and in Algeria. These posts are five in Africa: Dakar, Bamako, Fort-Lamay, Brazzaville and Djibouti; one in Madagascar: Tulear; two in the Pacific: Noumea and Papeete; finally two in the Atlantic: Fort-de-France and Cayenne. At present, they can only follow objects visible with a naked eye, but it is planned to provide them in 1960, after the Observatories have been equipped, with standard theodolite, probably of 100 mm aperture, to follow also weak objects. The system of communications is that of the Meteorology (teletype and radio).

Many hundreds of passages have been already observed at Meudon, at the Pic-du-Midi, and at many meteo stations (mainly El-Golea). The technique consists in following all the passages and determining the time and direction every 10 to 15 seconds; it allows to obtain an arc of 20 to 30 degrees on the orbit.

Photographic observation will be ready in a few weeks at Meudon and Strasbourg; it will be done with air-craft cameras K 37.

Radio emissions of satellites have been the subject of routine listening and studies on propagation at the RTF centre at Limours, at the Laboratoire National de Radioélectricité, and at the Centre National d'Etudes des Télécommunications.

France is interested in participation in the utilisation of the inflatable sphere to be placed in orbit as a passive reflector by the U.S.A., hopefully in 1960.

REPORT ON ACTIVITIES OF GERMAN FEDERAL REPUBLIC

Presented by J. Bartels

A National Committee for COSPAR has been established in December 1959. Work done in Germany was on tracking and orbit calculations using Doppler effects (Sternwarte Bonn, Dr. Priester) and on radio reception from satellites (Faraday effect). Moonwatch results of several amateur stations were transmitted to the data centres.

As a starting point for work on COSPAR subjects, a combined working group on space research is being contemplated in the Max Planck Gesellschaft to be formed from the Institutes for physics and astrophysics (Heisenberg, Biermann) and for aeronomy (Dieminger, Bartels).

REPORT OF JAPANESE NATIONAL COMMITTEE TO THE THIRD MEETING OF COSPAR

By K. Kaneshige

(Presented by Takeo Hatanaka)

I. Rocket Sounding

Nine Kappa Type VI rockets were launched in I958 as reported at the Second Meeting of COSPAR. In I959 four Kappa Type VI were launched for the observation of atmospheric temperature, wind velocity and solar radiation. During a test experiment for the development of rockoon firing technique, the brightness and polarization of zenith sky were measured with a balloon in October, I959.

The general plan for I960 and thereafter is to increase the maximum altitude of Kappa rockets, to increase the number of observational items and to develop the method of observation to cover a broader field of space research. Kappa Type VI rockets will be improved and be used for observation. Kappa Type VIII rockets will be developed to reach much higher altitude.

2. Satellite Observation

483 Moonwatch observations were made from January I to December 23, I959. 432 observations were made in the same period with the Baker Nunn Schmidt Camera at the Tokyo Astronomical Observatory. Before the films are sent to the Smithonian Astrophysical Observatory, approximate positions were measured. These readings are published for I958 and in press for I959.

Acquisitional radio observations are conducted at the Radio Research Laboratories, the Tokyo Astronomical Observatory and also by Amateur Radio League. Signals from Lunik II were received at the Laboratories for an hour on September I2. Signals from Sputnik III have been received since January I959 at the Laboratories to study the Doppler and Faraday effects. Telemetering signals from Explorer VII have also been recorded at all passage over Japan since its launching. The tapes are kept for study.

NETHERLANDS' REPORT ON NATIONAL ACTIVITIES

Submitted by Professor J. Veldkamp

(summarized at the COSPAR meeting by Professor H.C.v.d.Hulst)

Rockets have been launched from the coast of the Netherlands by the "Nationaal Luchtvaart Laboratorium" to an altitude of a few kilometers. This, of course, is not space research. However, these equipments were made for testing telemetering equipment and may be considered as a very modest preparation for later participation of the Netherlands in space experiments. The work will be continued.

In the field of tracking, groups of professional and amateur astronomers have regularly made visual observations of the transits of satellites ever since the first day of Sputnik I. These observations are reported to the Observatory at Utrecht and from there to the U.S.A. (spacetrack) and to the U.S.S.R. Radio signals from several satellites have been regularly observed by the N.E.R.A. receiving station of the Netherlands' P.T.T.

A wide variety of supporting research is conducted. The Netherlands have active institutes working in astronomy, radio astronomy, astrophysics, ionosphere studies, cosmic rays, plasma physics and other fields. In particular the studies of the solar corona of the interplanetary matter and of the ionospheric soundings and drift measurements may bear directly on space research.

The stations established in South America (Suriname) and New Guinea (Hollandia) of ionospheric stations during the IGY now have a permanent character.

A paper on solar X-rays is presented at the Symposium.

REPORT OF ACTIVITIES

IN THE UNION OF SOUTH AFRICA

Presented by Mr. D. Hogg

The South Africa contribution to space research is at present confined to the tracking of satellites by optical and radio means, and of recording their telemetry signals.

The major tracking equipment had been supplied by the United States of America as part of the IGY programme, and the long term operation of this equipment now falls under a new permanent South African Council for Scientific and Industrial Research Committee for International Relations in Science.

All tracking results are passed to Washington D.C. via a permanent teleprinter link. Precision optical tracking by a Baker Nunn camera sited near Johannesburg is carried out by an American staff controlled and financed by the Smithsonian Institute and NASA. Due to favourable seeing conditions in this area, the results obtained from this camera have been among the best of the 12 installed throughout the world. As an example, during June 1959, the station secured 106 photographs of satellites. Two of the best efforts obtained to date are a photgraph of 1958 Beta 2, the 6 inch Vanguard satellite at a range of 2,000 miles, and a picture of 1959 Delta 2 at 8,100 miles.

The South African moonwatch teams, organised on a volunteer basis around a number of observatories during the IGY are at present undergoing a reorganization which it is hoped will give them a more permanent status.

The Prime Minitrack radio tracking station also near Johannesburg is operated by a fulltime staff of South African personnel, and during its lifetime has recorded and analysed some 3,500 satellite transits.

It has recently been brought up to date as far as telemetry recording is concerned, by the installation of tape recording systems on both 20 Mc/sec and 108 Mc/sec, the latter including a a commend turn-on transmitter which has been sucessfully used to interrogate 1959 ETA (Vanguard III). Magnetic tapes are passed to U.S.A. for interpretation.

A further development in the radio tracking line, the installation of a large Space Probe Antenna in the Union, is under consideration, and a number of possible sites for such a station have been examined. This equipment would also be supplied by N.A.S.A. but it is probable that operational personnel would come from South Africa.

REPORT ON ACTIVITIES IN

THE UNION OF SOVIET SOCIALIST REPUBLICS

presented by Academician A.A. Blaganravov

1. STUDY OF THE UPPER STRATA OF THE ATMOSPHERE BY MEANS OF ROCKETS DURING THE I.G.Y. AND INTERNATIONAL GEOPHYSICAL CO-OPERATION.

In the period of the International Geophysical Year and International Geophysical Co-operation, 175 investigation rockets were launched in the Soviet Union (125 in the period of the I.G.Y. and 50 in 1959), with the aim of studying the upper strata of the atmosphere. By means of these projectiles a number of scientific investigations interconnected in time and space were carried out. The launchings of the investigation rockets were carried out on the territory of the U.S.S.R. in the areas beyong the polar circle, in the central latitudes of the European part of the country from ships, in the Southern hemisphere and in the Northern Pacific. The range of investigation has been considerably extended in altitude.

A. In the period of the I.G.Y. and the I.G.C., 158 meteorological investigation rockets were sent up with the task of studying the stratosphere. The distribution of the lauchings according to season and place is shown in the following table:

.... page 2

Launching of meteorological rockets

Month and year of launching		Places of Launching: All-round Antarctic expedition (diesel-electric ship "Ob"	High latitude observatory in Franz Joseph Land (Heisa)	Central latitudes of the European part of the U.S.S.R.		Total number of launchings
1957	July			2	2	14 launchings in 1957
	August			2	2	
	September			2	2	
	October			1	1	
	November		1		1	
	December	1	2	3	6	
1958	January	1	1	3	5	98 launchings in 1958
	February	3	3	3	9	
	March	6	3	1	10	
	April	8	1	1	10	
	May	3	3	2	8	
	June		2	2	4	
	July	9	3	4	16	
	August		2	3	5	
	September		4	5	9	
	October		5	7	12	
	November		5		5	
	December		4	1	5	
1959	January		2		2	46 launchings in 1959
	February		1		1	
	March			3	3	
	April		1		1	
	May		1		1	
	June				-	
	July			2	2	
	August			-	-	
	September		5	-	5	
	October		4	4	8	
	November		3	-	3	
	December	12 (North.Pac.)	2	6	20	
		43	58	57		158

.../page 3

During almost every launching the meteorological rockets were equipped with resistance electric thermometers and thermal and membrane monometers. In eight launchings the rockets were also supplied with devices for certain optic observations (the luminosity of the sky and the distribution of ozone were measured.).

As a result of the investigation carried out by means of meteorological rockets, a great amount of material on the temperature and pressure in the stratosphere has been accumulated. The preliminary analysis of the materials received has already yielded some information on the fluctuations of the temperature in the course of the year, on wind and temperature fields in the stratosphere, on the luminosity of the sky at various altitudes.

B. In the period of the I.G.Y. and the I.G.C. seventeen geophysical investigation rockets have been launched in the European part of the U.S.S.R. to a height from 100 to 470 km.

In six cases the rockets were supplied for the fist time with hermetically sealed, spherical self-orienting automatic containers with intruments for the registration of the structural parameters of the atmosphere, for carrying out optic observations and for registering the physical conditions outside and inside the container. The automatic orientation of the spherical container made it possible to carry out a number of reliable geophysical measurements, requiring definite orientation or the precise knowledge of this orientation. The spheric container together with the instruments weighed 367 kgs.

In seven cases the rockets simultaneously took to a height of up to 210 kilometres two containers and a detachable head section in which the research apparatus were located, as well a hermetically sealed cabin with experimental animals. The total weight of the scientific apparatus and the experimental animals attained 2,200 kilograms. A parachute system has been devised which ensures the reliable and safe return of the apparatus and the animals.

In four launchings, made in 1958, scientific equipment and experimental animals, contained in the detachable head section of a geophysical rocket, were taken for the first time to a height of 450-470 kilometres. The total weight of the experimental equipment and the hermetic cabin with the animals was 1,500 kilograms. This was achieved by means of a rocket stabilized throughout its flight. The stabilization of the rocket considerably increases the precision and value of the research carried out.

On August 27, 1958, the head section with the scientific apparatus and the animals safely landed for the first time from an altitude of 450 kilometres.

.../page 4

In the period of the I.G.Y. the following basic scientific equipment was carried by geophysical rockets :

No.	Kind of equipment	Date and time of the launching	Total number of flights
1.	Ultra-short dispersion radio-interferometer for measuring the concentration of free ions in the ionosphere	25.08.57 - morning 31.08.57 - morning 9.09.57 - evening 21.02.58 - daytime 27.08.58 - morning 19.09.58 - night 31.10.58 - daytime 2.07.59 - morning 10.07.59 - morning	9
2.	Radio-frequency mass spectrometer for the determination of the ion composition of the atmosphere	9.09.57 - evening 21.02.58 - daytime 2.08.58 - morning 13.08.58 - morning 27.08.58 - morning 19.09.58 - night 31.10.58 - daytime 2.07.59 - morning 10.07.59 - morning	9
3.	Apparatus for measuring the concentration of positive ions in the atmosphere	25.08.57 - morning 31.08.57 - morning 9.09.57 - evening 21.02.58 - daytime 27.08.58 - morning 19.09.58 - night 4.10.58 - daytime 10.10.58 - daytime 31.10.58 - daytime 23.12.58 - 25.12.58 - daytime 2.07.59 - morning 10.07.59 - morning 21.07.59 - morning 21.07.59 - evening	15

.../page 5

No.	Kind of equipment	Date and time of the launching	Total number of flights
4.	Instruments for measuring electronic temperature	21.02.58 - daytime 27.08.58 - morning 19.09.58 - night 31.10.58 - daytime 2.07.59 - morning 10.07.59 - morning	6
5.	Instruments for measuring atmospheric pressure	25.08.57 - morning 31.08.57 - morning 9.09.57 - evening 21.02.58 - daytime 2.08.58 - morning 13.08.58 - morning 27.08.58 - morning 19.09.58 - night 4.10.58 - daytime 10.10.58 - daytime 31.10.58 - daytime 23.12.58 - daytime 25.12.58 - daytime 2.07.59 - morning 10.07.59 - morning 21.07.59 - morning 21.07.59 - evening	17
6.	Vessel for air sampling	25.08.57 - morning 31.08.57 - morning	2
7.	Instrument for the registration of shocks dealt by particles and micrometeors	26.08.57 - morning 31.08.57 - morning 9.09.57 - evening 21.02.58 - daytime 2.08.58 - morning 13.08.58 - morning 27.08.58 - morning 19.09.58 - night 4.10.58 - daytime 10.10.58 - daytime 31.10.58 - daytime 23.12.58 - daytime 25.12.58 - daytime 2.07.59 - morning 10.07.59 - morning	15

... page 6

No.	Kind of equipment	Date and time of the launching	Total number of flights
8.	Solar spectograph for the registration of the ultraviolet part of the spectrum	25.08.57 - morning 21.02.58 - daytime 13.08.58 - morning 27.08.58 - morning 2.07.59 - morning 10.07.59 - morning	6
9.	Instrument for measuring the luminosity of the sky	4.10.58 - daytime 10.10.58 - daytime 23.12.58 - daytime 25.12.58 - daytime 21.07.59 - morning 21.07.59 - evening	6
10.	Instrument for the registration of the temperature of the borderline stratum of air	4.10.58 - daytime 10.10.58 - daytime 23.12.58 - daytime 25.12.58 - daytime	4
11.	Instrument for the registration of corpuscular flows	4.10.58 - daytime 10.10.58 - daytime 23.12.58 - daytime 25.12.58 - daytime 21.07.59 - morning 21.07.59 - evening	6
12.	Instruments for the study of cosmic rays	2.08.58 - morning 13.08.58 - morning 21.07.59 - morning 21.07.59 - evening	4
13.	Instrument for measuring electrostatic fields in the atmosphere	10.07.59 - morning	1
14.	Instrument for the registration of the X-ray radiation of the Sun	21.07.59 - morning 21.07.59 - evening	2

... page 7

No.	Kind of equipment	Date and time of the launching	Total number of flights
15.	Hermetically sealed cabin with animals and the equipment for the registration of their physiological functions	25.08.57 - morning 31.08.57 - morning 2.08.58 - morning 13.08.58 - morning 27.08.58 - morning 19.09.58 - night 31.10.58 - daytime 2.07.59 - morning 10.07.59 - morning	9

Here are the basic scientific results of the all-round studies of the upper strata of the atmosphere, carried out by means of geophysical rockets in the course of the I.G.Y. and the I.G.C.

New data have been obtained on the pressure, density and temperature of the upper atmosphere, which make it possible to create a physical model of the upper atmosphere up to the altitude of 450 kilometres.

For the first time in the U.S.S.R. the chemical composition of the upper atmosphere was determined by means of radio-frequency mass spectra, thus adding to the new materials on the increase of ions in the upper atmosphere.

By means of an ultra-short-wave dispersion interferometer, equivalent electronic concentrations have been determined at altitudes from 100 to 470 kilometres, including areas above the maximum of ionospheric strata. At altitudes of over 380 kilometres electronic concentrations have been determined for the first time. It has been established that apart from the F area, there are no strictly defined layers in the ionosphere. Only small individual electronic condensations have been found against a general background of the gradual increase of electronic concentration up to the maximum of the F layer. At altitudes exceeding this layer electronic concentration decreases. The rate at which the electronic concentration of the outer part of the ionosphere decreases slightly changes according to the time of the day and the season, yet at altitudes of 450-470 kilometres the value of electronic concentration is always high.

Methods and equipment permitting not merely to register the number of shocks dealt by micrometeors, but to determine their power indices have been evolved and tested. The average registered number of shocks amounts to about $1.7.10^{-3}$ shocks/ m2 per second, but at the same time short but violent

... page 8

increases in the number of shocks have been registered (for instance, up to nine shocks per square metre at an altitude of about 470 kilometres). The analysis of the impulses registered by the gauges shows that the registered meteor particles possess an energy of about 10^4 erg.

Interesting data have been received on the distribution of the luminosity of the diurnal and nocturnal sky, in integral light, and in individual integral areas.

Photographs have been taken of the ultra-violet spectrum of the Sun. Data have been received concerning the distribution of energy in the different parts of the spectrum.

Experiments have been made in the photography of the surface of the Earth and cloud systems from great altitudes.

The height dependence of the global intensity of charged particles has been obtained up to an altitude of 210 km.

The physiological observations of animals under rocket flight conditions have been continued and extended. It has been established that the flights of animals to altitudes up to 470 kilometres o not cause any pronounced disorders in their physiological functions. The changes in physiological functions were particularly marked during the active movement of the rocket and in the period of its slowing down; during dynamic imponderability lasting 6-10 minutes the indices of the basic physiological functions returned to normal after 5-6 minutes.

.... page 9

II. STUDIES OF COSMIC SPACE BY MEANS OF ARTIFICIAL SATELLITES AND COSMIC ROCKETS

With the object of studying the upper strata of the atmosphere and other geophysical phenomena and cosmic space, three artificial Earth satellites were launched.

	Launching date	Total weight (kg)	Maximum flight altitude	Main tasks
1	2	3	4	5
First Soviet Earth satellite	October 4.1957	83.6	947	Systematic radio-technical and optic observation of the orbit Study of the spread of radio waves in the ionosphere.
Second Soviet Earth satellite	November 3.1957	508.6 (weight of apparatus)	1671	Study of the behaviour and the physiological functions of the animal during space flights Study of cosmic rays Study of solar radiation in the short-wave ultraviolet and X-ray areas
Third Soviet Earth satellite	May 15 1958	1327	1881	Determination of pressure and the composition of the atmosphere Measurements of the concentration of positive ions Measurement of the value of the electric charge of the sputniks and the tension of the electrostatic field of the Earth Study of the intensity of solar corpuscular radiation. Measurement of the tension of the terrestrial magnetic field Study of the composition and variations of the primary cosmic radiations and the distribution of photons and heavy nuclei in cosmic rays. Study of meteor particles

... page 10

The main results of the investigations carried out by means of the three Soviet artificial Earth satellites are as follows :

Determination of the density of the atmosphere both by means of studying the changes in the parameters of the orbits of the sputniks, and by means of direct manometric measurements.

By means of radio-frequency mass spectrometers the ion composition of the ionosphere at altitudes up to 840 kilometres has been studied for the first time. The measurements showed that above 250 kilometres the atmosphere has a mainly atomic composition with the prevalence of ions of atomic oxygen. A noticeable concentration of ions was found at altitudes of about 1000 kilometres, a fact speaking of a considerably greater extension of the atmosphere than previously supposed.

Radio observations of the first earth satellites showed that the electronic concentration above the maximum of ionization decreases at a rate which is 5-6 times slower than the increase in these concentrations below the maximum. This agrees with the results of the rocket investigations. For a considerable period of time the concentration of positive ions was directly measured by means of ion traps. At an altitude of 795 kilometres the summary concentration of positive ions was found to amount to $1.6 \cdot 10^5$ ions per one cubic cm.

The tension of the magnetic field of the Earth was measured by means of a magnitometer set up on the third satellite. The analysis of the data obtained showed the existence of short and rapid changes of the magnetic field, coinciding in time with the passing of the sputnik through layer F2 of the ionosphere, a fact which probably shows the presence of current systems in the upper strata of the atmosphere. Some other information on the magnetic field has also been obtained.

Pieso gauges registered the frequency of the shocks dealt by micrometeors as $1.7 \cdot 10^{-3}$ shocks to one square metre per second. A short period with an increased number of shocks (up to 22 shocks to one square metre per second) was noted at an altitude of 1700-1880 kilometres). The overwhelming majority of the particles registered possessed an energy of about 10^4 erg and a mass of about 10^{-9} gr.

By means of fluorescent gauges and photographic amplifiers set up in satellite III, electronic flows were registered, whose intensity increased with altitude and over high geomagnetic latitudes. It may be supposed that the energy of the electrons constituted about 10 kev. It is important to note that the intensity of the electronic

... page 11

flows observed was sufficient to create X-ray radiation whose protracted effect could be dangerous for living creatures.

The counters set up on the second artificial satellite made it possible to determine the dependence of the intensity of the primary cosmic radiation on altitude and geographical latitude and longitude. It was found that at medium altitudes the intensity of cosmic radiation rises by about 40 per cent when the altitude is changed from 225 to 700 km. Short periods of fluctuations in the intensity of cosmic radiation have been observed. The lines of the permanent intensity of cosmic radiation were found to be non-coincident with the geomagnetic parallels.

The apparatus for the study of cosmic rays set up aboard the third satellite ensured, - apart from the measurements of the total intensity of these rays, - the registration of photons and atomic nuclei of heavy elements in cosmic radiation.

The medical and biological experiment concerning the vital functions of a living organism, carried out on the second sputnik, gave valuable information on the behaviour of the animal under conditions of cosmic flight. The analysis of the data obtained makes it possible to assert that the animal [illegible] in a completely satisfactory manner the orbiting of the sputnik when the overcharge is considerable. The condition of imponderability also failed to cause any essential and lasting changes in the physiological activity of the animal. Thus it may be considered as established that the animal withstands cosmic flights in a satisfactory manner.

The launching of cosmic rockets was the next stage in the scientific exploration of the cosmic space and the geophysical phenomena taking place there.

... page 12

	Date of launching	Total weight of scientific and measuring devices	Basic tasks
1	2	3	4
Cosmic rocket I	January 2, 1959	361.3 kg	Magnetic field of the Earth measured and magnetic field of the Moon explored. Cosmic radiation studied Gaseous component of interplanetary substance and of corpuscular solar radiation studied. Meteor particles studied. Formation of artificial sodium comet and its observation.
Cosmic rocket II	September 12, 1959	390.2	Surface of the Moon attained. Cosmic radiation studied. Gaseous component of interplanetary substance studied. Magnetic fields of the Earth and the Moon measured. Radiation belts round the Earth studied. Meteor particles studied.
Cosmic rocket III	Otober 4 1959	435 kg	Flight round the Moon of automatic interplanetary station carried out; station carried radio-engineering, photo-TV and scientific equipment. Reverse side of the Moon photograph and picture transmitted to the Earth. Continuation of the research made in the previous cosmic rockets.

... page 13

The basic results of the investigations carried out by means of cosmic rockets are as follows :

- measurement of the intensity of primary cosmic rays as well as X-rays and gamma-rays in interplanetary space;
- determination of the composition of the charged particles in cosmic space;
- detection and study of the outer belt of intense radiation with a maximum of intensity at the distance of four radii from the centre of the Earth;
- discovery of a system of non-ionospheric currents at an altitude of about 3-9 terrestrial radii ;
- quantitative measurement of the magnetic field near the Earth and in cosmic space showing that there is no noticeable magnetic field near the Moon.

... page 14

THE FUTURE OF SPACE EXPLORATION

Present-day rocket techniques have placed at the disposal of scientists great opportunities for experimental studies of outer space. The results already obtained in this direction are of fundamental significance. But these are only the first steps, the first penetration into a world unknown.

At present it is possible to note a number of trends along which space exploration will develop. The first is the further study of the upper atmosphere of the earth and of circum-terrestrial space by means of artificial earth satellites.

The programme of scientific investigation by means of satellites is vast: it envisages the study of the ultraviolet and X-ray spectra of the sun and other astronomical objects, the obtaining of a map of the stellar sky in different parts of the spectrum, photography of the solar corona and of various nebulae, cosmic-ray studies, studies of the structure of the terrestrial magnetic field and its relationship with solar activity, studies of the ionosphere, the degree of ionization and its composition, the propagation of radio-waves through the ionosphere, studies of the gravitational field of the earth, and also the establishment of a high-precision time service for astronomical purposes. By way of preparation for manned flights into outer space, a broad range of biological studies is being planned. The problem is posed of making a broad and comprehensive study of the action of cosmic radiation on living organisms, and of mapping out protective measures against these radiations. In this connection, special containers bearing plants and also highly organized living beings are to be sent into outer space.

In accordance with the programme of scientific investigation, we plan to launch a series of satellites.

The second stage will encompass lunar exploration and studies of the vicinity of the moon. Soviet space rockets have already reached the surface of the moon and have proven that the moon lacks an appreciable magnetic field. The first photographs of the reverse side of the moon have been obtained by the automatic interplanetary station. This success of Soviet science and technology has translated into reality the dream of interplanetary flight, and places on the agenda the solution of problems that just yesterday had seemed fantastic. We plan to continue studying the moon.

Later, we hope --on the basis of experience that will be gained-- to carry out a series of experiments with rockets sent to planets of the solar system, in the first place, to Mars and Venus.

Intruments brought into immediate proximity with the surfaces of other planets will permit, in the near future, to solve one of the mysteries of the world --the existence of life on other planets.

... page 15

The range of problems connected with calculating the motion of space vehicles comprises a new field in celestial mechanics. For the first time in the history of astronomy, calculations are made of artificial celestial bodies, including such unusual bodies as those which are able actively to influence the character of their motion. Studies of the motion of these artificial bodies will permit obtaining new data on the astronomical constants of the solar system and of gravitational fields.

In solving the problems that I have enumerated we shall encounter tremendous scientific and technological difficulties. But we are confident that they will all be solved if the collective efforts of the scientists of many countries are united, if progress in science and technology is directed towards the solution of peaceful problems, and these include the exploration of outer space.

REPORT OF UNITED KINGDOM ACTIVITIES

The main contributions in the U.K. fall into four categories, viz:

1. Upper atmosphere Research with Rockets.
2. The tracking, both optical and radio, of satellites and space probes.
3. Activities of the Satellite Prediction Service and World Data Centre C.
4. The design of scientific instruments for use in Satellites, and design studies of methods whereby British rockets could be used to launch earth satellites.

Upper Atmosphere Research with Rockets

The British contribution in this field has been developed jointly by the British National Committee on Space Research and the Ministry of Aviation, using the Skylark upper atmosphere research rocket.

This rocket is launched at Woomera in South Australia, by agreement with the Australian Department of Supply, and with the help and co-operation of the Woomera Rocket Range authorities.

A number of successful experiments have been carried out during 1959, the following being the most important:-

University of Belfast: (see Appendix I)

Measurements of upper atmosphere winds and temperatures by the observation of sodium clouds released from rockets.

University of Birmingham: (see Appendix II)

The use of positive ion spectrometers ejected from the rocket on a long cable, to record ion spectra at heights ranging from the lower ionosphere to approximately 150 Km. The measurement of electron density by a dielectric method has detected a narrow sporadic 'E' layer at about 100 Km. altitude.

University College London: (see Appendix III)

Data on upper atmosphere winds and temperatures have been obtained from observations of grenade bursts. Solar Lyman radiation and solar X rays have been monitored by nitric oxide ionization chambers and emulsion detectors. Langmuir probe equipment has been used to study sporadic E ionization, and electron and ion concentrations in the ionosphere.

Imperial College London (Department of Meteorology)

Observations, by radar, of the motion of clusters of resonant dipoles released from rockets have yielded data from which upper atmosphere winds can be deduced.

Imperial College London (Department of Physics)

The variation of Cosmic Ray intensity with height above Woomera, Australia, has been determined up to an altitude of some 700 Km. using a single Geiger Counter.

International Rocket Week 1959

Three Skylark rockets were prepared for launching during the week 16 - 22 November, 1959. Unsuitable weather delayed the firings, but all three were successfully launched on November 30th - December 1 st. The results will be made available when analysis of the data has been completed.

The main experiments carried out were:

Observations of Sodium Vapour trail, giving wind and temperature data.
Observations of Grenade bursts, giving wind and temperature data.
Observations of electron density, using a dielectric method.
Observations of the drift of a cluster of resonant dipoles, giving wind data.

Future Rocket Research Programme

It is intended that the experimental programmes of the Groups already mentioned will be continued and widened during 1960. In addition, early firings concerned with measurements of the geomagnetic field, observations in the ultra violet of the Southern sky, and ionospheric investigations using propagation methods, are planned.

Exhibits relating to most aspects of the U.K. Rocket Research programme will be found in the Exhibition.

Tracking of Satellites and Space Probes

The optical and radio tracking of satellites and space probes has continued broadly along the lines described in the Royal Society booklet of February 1959, 'Report on U.K. Observations of Artificial Earth Satellites and Associated Research'.

There are plans to extend the optical observations by kine theodolites or other instruments, in particular by distributing sites more widely so as to minimize bad weather limitations.

The radio telescope at Jodrell Bank, near Manchester, has been used on a number of occasions to receive signals from both American and Russian space probes, and the Radio Research Station at Slough is extending its facilities for radio tracking.

World Data Centre

The World Data Centre for rockets and satellites established at the Radio Research Station, Slough, in October, 1958 is fulfilling its intended purpose of collecting data on space research and exchanging it with the other two centres in Washington and Moscow.

The flow of data is still relatively small and consists mainly of satellite positional observations, though reduced radio observations table of orbital elements and ephemerides of certain satellites are also being received. The Centre houses a large number of published and unpublished reports, many of which contain the results of investigations with rockets and satellites. Two catalogues of the material in the Centre have now been issued.

Predictions and Orbital Computations

The service of providing predictions of the times and direction of transit of satellites passing within radio range of observers in the British Isles has continued. Predictions have been issued regularly for Sputnik 3 and Explorer 6 (1959 Delta), Explorer 7 when transmitting and for Atlas (1958 Zeta), Discoverer 5 (1959 Epsilon) and Discoverer 6 (1959 Zeta) when visible from this region. Predictions were also issued from time to time on Explorer 4 (1958 Epsilon) and Explorer 6 after their transmitters had ceased to function. Over one hunderd establishments and observers received the predictions at weekly intervals.

The data required for making the predictions has been obtained from information on the orbits issued by the launching country and from optical and radio observers in the British Isles and Western Europe.

Design of Scientific Experiments, and Instruments for use in Earth Satellites

In May 1959 the British Government announced its approval of a programme for the design and construction of instruments to be carried in earth satellites. A number of groups, both at Universities and Government Establishments, have commenced work, and between them cover a wide field of scientific interest. Their scientific activities are coordinated and assisted by the British National Committee on Space Research, of the Royal Society.

Meanwhile, following the offer of the U.S. National Academy of Sciences to launch complete scientific payloads in artificial earth satellites for other countries, informal discussions have been held between U.K. scientists led by Professor Massey, and the N.A.S.A. authorities. Professor Massey's team had most valuable and fruitful discussions with N.A.S.A. As a result British scientists are preparing instruments for satellites to be placed in orbit by the use of the 'Scout vehicle, which N.A.S.A. are developing for use in connexion with civil scientific research. Several vehicles might be involved over a period of three to four years.

The British Government acting on the advice of the Steering Group on Space Research set up by Lord Hailsham to assist him in his task of supervising the United Kingdom Space programme have considered and approved these proposals, subject to the conclusion of formal arrangement which it is hoped to complete shortly.

A letter to the President of COSPAR gives notifications of these arrangements.

In addition, the British Government have put in hand design studies for the adaptation of British military rockets now under development, which will put us in a position, should we decide to do so, to make all-British launchings of earth satellites.

APPENDIX I

Statement on Skylark Experiments by The Queen's University of Belfast

The first sodium ejection round, prepared in the United Kingdom was fired on December 3rd, 1958, and was successful. The photographs taken by the ballistic cameras were measured by U.C.L. and gave winds from 90 - 120 Km. The trail was also photographed through a Fabry-Perot interferometer so that its temperature might be measured from the fringe profile. Due to the fading of the trail, the plates were under-exposed. However it seems that the temperature of the sodium cloud had fallen to a value quite near that of the atmosphere within 7 minutes of ejection.

This experiment was repeated on November 30th, 1959, and was also successful. The interferometer exposure sequence was modified to suit the known decay in brightness of the trail after formation, but the plates have not yet been received. The reduction of the wind results will be done by two methods. For the first, the Deuce computer will be used, and for the second, three projectors will re-project a scaled-down model of the trail.

Investigations were begun on the possibility of replacing the present large heavy sodium burner by small light grenades to be ejected from the rocket.

For a variety of reasons, the photometer round in Australia since August, 1958, was not fired, but it is hoped that this, and another of similar type will be fired early in 1960. These rounds will also carry microphones for the detection of micrometeorites.

APPENDIX II

Skylark Rocket Programme

January - December 1959

The University of Birmingham

During the current year three rocket flights carrying Birmingham instrumentation took place at Woomera. Of these S1.12 and S1.15 which were fired in September, contained positive ion spectrometers. The instrumentation in each case consisted of two parts:

(i) A measuring head consisting of the ion 'cage' and its associated amplifiers which was ejected from the vehicle on a long cable after the rocket had cleared the major atmospheric drag.

(ii) The main ion current amplifiers and electronic coding circuits, necessary for the preparation of the data for the telemetry link, which were located in the vehicle.

Of the two flights, S1.12 was unsuccessful as the measuring head did not eject from the rocket until near the re-entry point, and although the equipment was functioning normally at this time the altitude was too low for an ion spectrum to be obtained.

S1.15, on the other hand, was entirely successful and a satisfactory ion spectrum was recorded at heights ranging from the lower ionosphere up to the maximum of the flight which was approximately 100 miles attitude.

It is still too early in the data reduction to present any firm conclusions on the results obtained. It is, however, already clear that the 'E' region ionisation during the day contains positive ions of two types whose population densities are of comparable magnitude. These ions are of mass number approximately 16 and mass number approximately 29. But we do not feel able at this stage to identify them chemically.

The third flight, which occurred on the 1st December at 9 p.m. local time, was instrumented with the original dielectric electron density set. The results obtained on this flight have not yet been analysed as the detailed record has not reached Birmingham. From advance information received it appears that a narrow sporadic 'E' layer was encountered at approximately 100 Km altitude similar to that observed during the June 1958 flight.

APPENDIX III

University College London Skylark Experiments 1959

U.C.L. equipment was carried in 6 Skylark rockets fired ring 1959.

. 2 Grenade experiments on upper atmosphere, winds and empeatures were carried out during the recent World Rocket Week. One of hese was successful to the full height and in addition persistent glows ere obtained from grenade bursts above 100 Km. In the other grenade ound only a small number of grenades was ejected but the bursts from ese were successfully recorded. Analysis of this data is not yet omplete.

. One rocket carried NO ionisation chambers to monitor the olar Lyman-a radiation and emulsion detectors to measure the solar X-ray ux in the wavelength regions 1 - 8 Å and 8 - 10 Å. Both these experiments re successful and preliminary analyses of the data show the fluxes to ve been normal for quiet solar conditions.

. Three rockets carried Langmuir probe equipment aimed to study poradic-E ionization, electron and ion concentrations in the ionosphere. e flight showed a normal daytime positive ion profile starting from 5 Km. with no trough between the E and F regions. The other two flights ere also successful but data awaits analysis.

Report on

SPACE RESEARCH PROGRAM

OF THE UNITED STATES OF AMERICA

As Presented to COSPAR

By Dr. Richard W. Porter, Representative

of the National Academy of Sciences,

U.S.A., 9 Jan. 1960.

I. Introduction.

At the COSPAR meeting in The Hague on 12-14 March 1959, the objectives of the United States space science program were presented and a brief review was given of both short and long-range plans for experiments in support of the stated objectives. These objectives and the long-range plans remain essentially the same and need not be restated at this time. Furthermore, United States space research accomplishments of 1958 and before have been reasonably well covered at The Hague and elsewhere. This Report therefore will be concerned primarily with a review of results and accomplishments during 1959 and a summary of the current plans for 1960.

II. Some Results.

During 1959 four scientific satellites were successfully placed in orbit. These were Vanguard II, Explorer VI, Explorer VII and Vanguard III. Pertinent details on these satellites are summarized in Table I.
It may be noted in connection with the completion of these launchings, that all ± 64 satellite experiments originally proposed by the United States have been successfully carried out.
In view of the interest which has been expressed by scientists of several other nations in recording and reducing f r their own purposes data from Explorer VII, and the synoptic value of obtaining such data over a wide geographical area, the United States National Aeronautics and Space Administration has asked me to announce that telemetry codes and calibrations will be made available in the near future to any scientists who have the desire and capability to use them. Requests should be made through the Space Science Board of the United States National Academy of Sciences.

One space probe, Pioneer IV, was launched successfully, passing by the moon and proceeding out into space to orbit about the sun as an artificial planet. The results obtained from Pioneer IV are summarized in Table 2.

On August 17, 1959, a sounding rocket was launched by

../..

the U.S. National Aeronautics and Space Administration (N.A.S.A.) at Wallops Island, Virginia, for the study of upper winds and diffusion processes. The rocket, launched at dawn, carried equipment to eject atomic sodium into the upper atmosphere. It reached an altitude of 240 kilometers and the sodium cloud was visible, from its yellow fluorescence in the dawn sunlight, for hundreds of miles along the Atlantic seaboard. The growth, shape, and dissipation of the cloud was photographed from four different stations furnishing data concerning diffusion, wind, and wind shear. Values of wind velocity greater than 250 meters/sec toward the southwest were measured at altitudes above 150 km. Analysis of the data is continuing.

A second sodium flare rocket was launched successfully at Wallops Island at evening twilight on November 18, 1959 during the COSPAR International Rocket Week. This rocket reached an altitude of 250 km. Once again the atomic sodium cloud was visible over a very wide range. Preliminary results from this experiment show an abrupt change from turbulent motion to a uniform atmosphere at about 120 km altitude, and very low wind velocities in the 200 km altitude region as compared to the August dawn firing.

On September 11, and 14, 1959, the N.A.S.A. launched two rockets for Arctic ionospheric studies. Both launchings were successful and the experimental equipment performed well. Electron density data obtained by the CW propagation experiments were used to calibrate direct measurement devices (Langmuir probes, electron ion traps, and field meters) to be used in the instrumentation of a future satellite for studying the structure of the ionosphere.

Other successful scientific rocket launchings by the United States during 1959 included twenty-eight by the Air Force Cambridge Research Center, Geophysics Research Directorate at White Sands, N.M., Fort Churchill, Canada, and Eglin Field, Florida. Fourteen of these rocket tests were chemical release (cesium) experiments, one was a measurement of day air glow, two were magnetic field measurements (one during the International Rocket Week), five were studies of the ionosphere (one during the Int. Rocket Week), four yielded atmospheric pressure, temperature and density measurements (two during the International Rocket Week), and three contained spectroscopic experiments.

The Naval Research Laboratory also successfully conducted a number of scientific rocket tests including one which obtained more than sixty photographs of the solar disc at the Lyman-Alpha wavelength (some of which show excellent detail) and also recorded solar spectral intensities down to the Helium region (584 A°).

../..

Another NRL rocket yielded photometric measurements of the night airglow in a variety of interesting spectra bands running from OH (7280 A° - 10000°) to ultraviolet (2780 A°) and also scanned the sky with a detector sensitive in the 1225 - 1315 A° extreme ultraviolet region. This latter test indicated the presence of at least seven major sources, three of which have been tentatively identified with the Pleides, Orion, and Achenar. Yet another NRL rocket measured X-rays with energies as high as 80 KEV at an altitude of < 43 km during a class 3 + solar flare. Altogether the Naval Research Laboratory was responsible for a total of ten successful rocket experiments during 1959.

The Army Ordnance Ballistic Research Laboratory had one very successful rocket launching from Wallops Island, Virginia on 10 November (six days before the International Rocket Week) in which ion density was measured to an altitude of 1050 miles.

III. Plan for Calendar Year 1960.

At the present time, six satellites are scheduled for Basic scientific research during 1960. Two of these are to be placed in highly eccentric orbits for the study of the trapped radiation belts. One is scheduled for investigation of electron densities in the ionosphere by means of the various ion probes that were tested during 1959 on the sounding rocket flights described in the previous section. Another will be used to determine the properties of the ionosphere by analysis of data obtained from ground stations receiving a series of harmonically related radio signals transmitted from the satellite. It is planned at the present time to use the following frequencies: 20.005; 40.010; 41.00025; 360.09; 108.027; and 960.24 Mc/sec., although some changes may be necessary as a result of recent action by the Int. Telecom. Union. A satellite will be flown to study the high energy gamma rays entering the vicinity of the earth from our galaxy and possibly from other galaxies. Finally, the sixth satellite is scheduled for a spectrophotometric study of the sun's corona and chromosphere in the ultraviolet and X-ray wavelengths; high-resolution line spectroscopy in the ultraviolet will be attempted. These satellite flights are listed in Table 3.

In addition, two space probes and one geophysical probe are tentatively scheduled for calendar 1960. One of these will be directed generally inward toward the sun (to an aphelion of approximately 2/3 A.U.) for experimentation with communications techniques across the solar system, study of solar influence on the trapped radiation belt, and observation of cosmic rays and other high energy particles as well as magnetic field variations in interplanetary space.

../..

A second probe is scheduled for measurement of interplantary plasma density simultaneously with precision magnetic field measurements. A rubidium vapor magnetometer will be used in this experiment. The geophysical probe will make use of one of the early Scout test vehicles, launched in such a way as to rise to a distance of one or two earth radii and then return. It will be used for radio propagation measurements of the electron density profile beyond the F-region maximum of the ionosphere. These tentatively scheduled probe launchings are listed in Table 4.

Sounding rocket research will continue at about the same level as during 1959. Experiments on the earth's atmosphere, its ionosphere, energetic particles, magnetic fields, and rocket astronomy will be conducted along with a number of special observations such as the sodium flare work described in the previous section. The approximate magnitude of each of the programs is indicated in Table V. The United States plans to participate in the 1960 International Rocket Week and the U.S. National Academy of Sciences will inform COSPAR of specific rockets to be fired in conjunction with the Rocket Week program as soon as the detailed plans have been firmly established by all U.S. Agencies.

IV. Additional Information on the U.S. Space Program.

A large number of small meteorological rockets will be fired daily during January, April, July and October 1960 from each of six North American stations for the purpose of measuring wind direction and velocity at altitudes from 40 to 70 km. The six stations are located in Virginia, Florida, California, New Mexico, and Alaska, U.S.A., and Fort Churchill, Canada. A seventh station may be established later in Greenland. The measurement technique will be based on use of metallized resonant dipoles and reflective parachutes as radar targets. Data will be deposited at World Data Center A for Meteorology at Ashville, N.C., in the U.S.A.

In the field of meteorological satellites, Tiros I is scheduled for launching in the first part of calendar year 1960. A second meteorological satellite, Tiros II, will be launched about 400 mi. altitude. The major equipment in these satellites consists of two television cameras for the observation of cloud cover, and infrared detectors for determining solar-terrestrial energy relationships. The useful life of each is expected to be about 3 months.

A 100 ft. inflatable sphere is scheduled to be launched into a very high circular orbit in the Spring of 1960. The plan is to use this inflatable sphere as a passive reflector in various types of radio communication systems.

This particular Project is designated "ECHO" in the United States, and has been described in a report that has already been distributed through COSPAR. It is hoped that many scientists throughout the World will plan to make use of this "ECHO" satellite in appropriate ways during its lifetime. Obviously a launching of this type may encounter certain difficulties and several attempts may be required in order to put it in orbit. Thus it cannot be scheduled exactly. However, in order to provide ample time for other scientists and engineers to plan their experiments and procure the necessary equipment, the United States National Aeronautics and Space Agency has consented to make this advance information available. It is planned to follow this procedure in the future also whenever it is believed to be in the interest of the broadest possible participation by scientists in the utilization of United States space experiments.

In Project Mercury (United States N.A.S.A. manned space-flight program), the testing of the capsule to be used continues, including airdrop tests, escape system studies, free flight, and wind tunnel investigations, impact tests, parachute tests, and tests of the life support system. The capsule was tested under reentry conditions in early September. The ablation heat shield performed well and the test was considered so satisfactory that a backup shot was cancelled.

Scientists in a number of countries have responded to the offer made by the United States at the March 1959 COSPAR meeting to launch mutually agreeable scientic experiments or complete instrument packages prepared by scientists of other nations. This offer, as described in the Minutes of the COSPAR meeting, is still open. The Royal Society of U.K. and the Canadian National Research Council have already reported concerning their proposals. Other proposals are still in the early stages of preliminary discussion; however, as definite plans materirialize from these discussions, it is expected that COSPAR will be fully informed by the scientific institutions or agencies concerned and will be asked for scientific advice and comment.

TABLE I

U.S. SCIENTIFIC SATELLITES LAUNCHED IN 1959

Vanguard II

Date: February 17, 1959.

Weight: 20.74 pounds.

Orbit: 347 - 2064 miles; 33°.

Experiments: Crude images of the earth's cloud cover. Prepared by the U.S. Signal Research and Development Laboratories.

Results: The satellite developed an unanticipated precessing motion which makes interpretation of the data very difficult.

Explorer VI

Date: August 7, 1959.

Weight: 142 pounds.

Orbit: 156 - 26,357 miles; 47°.

Experiments: This satellite contained instruments for measurements in the Van Allen Radiation Belt, provided by the Universities of Chicago and Minnesota, and by the Space Technology Laboratories. It also contained instrumentation for the measurement of the earth's magnetic field and for a type of one-line televison scanning of the earth's cloud cover provided by the Space Technology Laboratories. NASA and the Air Force Cambridge Research Center provided equipment for the measurement of micrometeorites. The Stanford University provided equipment for the observation of very low frequency radio signals.

Results: (University of Chicago)

1. High-energy (10-20 Mev) radiation on the inner side of the radiation belt region. This appears to be a narrow proton band, 500 km thick, at about 2000 km out from the earth. The total counting rate at maximum is about 1400 counts per square centimeter per second.

2. In the vast outer low-energy radiation region, no protons are observed with energies greater than 75 Mev or electrons with energies greater than 13 Mev.

../..

3. There are indications of variation with time.

(University of Minnesota)

1. The intensity of the radiation region at great distances dropped to a much lower level than was noticed by Van Allen in the Pioneer probes, 5000 times less than Pioneer IV and 10 times less than Pioneer III.

2. Maximum intensity was at 22,000 km from the earth's center.

3. The radiation regions show pronounced and complicated structure.

4. An attempt is being made to map the radiation levels and study the character of the radiation by the relative responses of the different instruments.

5. This instrumentation shows the same region of hard radiation as that found by the University of Chicago.

6. Toward the end of August, the radiation layers were filling up at large distances and had reached an intensity comparable to that of Pioneer III.

7. There are some "pockets" of radiation at large distances which appear and disappear with time. The increase appears to be correlated with solar outbursts.

(Space Technology Laboratories)

1. On August 20, during a solar eruption, the maximum intensity was observed to increase by a factor of 10 to 100 from the maximum on quiet days.

2. However, on August 16, when there also was high solar activity and an intense magnetic storm, there was no increase recorded.

3. Fluctuations of intensity indicate that both the inner and outer zone are much more complicated than has been previously indicated.

4. One hundred forty traversals of the radiation belt indicate that the low energy radiation zone has a gross structure similar to the radiation belts reported by Van Allen.

../..

5. The television scanner data gives *very crude image* a which correlates roughly with data from meteorological maps.

6. The reduction of data from the magnetic field experiment is quite involved. No unexpected findings have yet been produced.

(NASA and the Air Force Cambridge Research Center)

1. Preliminary data analysis indicates a relatively low micormeteor counting rate compared to data obtained from earlier experiments.

(Stanford University)

1. The signal from the Navy's VLF 15.5 kc/sec transmitting station NSS was received clearly below the D region of the ionosphere, but dropped out after passage through the D region at 70 km altitude.

2. VLF data obtained in orbit is still under analysis.

Vanguard III

Date: September 18, 1959

Weight: 50 pounds

Orbit: 320 - 2329 miles; 33.34°

Experiments: Solar X-radiation, by the Naval Research Laboratories; micrometeorite and satellite temperatures, by the Goddard Space Flight Center; and earth's magnetic field, by the Goddard Space Flight Center; and earth's magnetic field, by the Goddard Space Flight Canter.

Results: (Naval Research Laboratory)

1. Because of the high apogee, the solar radiation ionization chamber saturated most of the time, making it impossible to pick up the solar X-radiation; however, good information is being obtained on the structure of the lower edge of the Van Allen Radiation Belt.

(Goddard Space Flight Center)

1. The magnetometer worked well and preliminary

../..

analyses of selected portions of the data indicate that in some locations systematic deviations occur from the predicted fields. The erosion experiments have not indicated that any appreciable erosion has taken place. The micrometeorite experiment has reported from 4 to 15 impacts of particals 10^{-9} gm or larger per square meter per hour. Payload temperature varied between 6^{0} C and 27^{0} C.

EXPLORER VII

Date:	October 13, 1959
Weight:	91.5 pounds
Orbit:	344.5 - 677.9 miles; 50.3°
Experiments:	Solar Lyman-alpha and X-rays by the Naval Research Laboratories; heavy primary cosmic rays, by the Research Institute for Advanced Study of the Glenn L. Martin Company; total cosmic ray counting rate, by the State University of Iowa; the radiation balance in the earth's atmosphere, by the University of Wisconsin; micrometeorites and satellite erosion, by Goddard Space Flight Center; and satellite temperatures.
Results:	1. The 20 mc/sec. transmitter is functioning properly on solar power supply and will probably continue for many months. The 108 mc/sec. transmitter exhausted its chemical batteries and stopped transmitting in December 1959. All data are in early stages of analysis and results are very tentative.

2. The meteorological radiation balance experiment is yielding approximately one thousand measurements per day. The sensitivity is sufficient to distinguish hot and cold air masses at night and cloud cover in daylight, comparison with balloon born radiometers indicates reasonable accuracy with respect to measurement of net outward energy flux.

3. Further mapping of variations in the trapped radiations seems to be giving additional evidence of correlation with magnetic storms.

4. The "heavy" cosmic ray experiment seems to be

../..

functioning properly; data is still being processed.

5. As expected, the solar X-ray and ultra violet experiments are adversely affected part of the time by trapped radiation. No solar data has yet been obtained but it is still hoped that a sizeable solar disturbance may occur at a time when these instruments will be able to record the accompanying radiation.

6. No significant micrometeorite penetrations or erosion have yet been observed, nor have the solar cells indicated any change in operation during the first 80 days.

7. Internal temperature has varied from 19°C to 42°C as the orbit charged from minimum to maximum time in sunlight.

TABLE 2

U.S. Space Probe Launched in 1959

Pioneer IV

Date:	March 3, 1959
Weight:	13.4 pounds
Experiment:	Radiation belt investigations, by the State University of Iowa
Results:	1. The outer zone was much more intense in Pioneer IV than in Pioneer III.
	2. The inner peak of the Pioneer IV data was not significantly different from that of Pioneer III.
	3. Pioneer IV showed a detailed structure to be present, especially from 60,000 to 90,000 km.
	4. There was direct evidence of a solar origin for the outer radiation zone.
	5. There was no solar plasma energetic enough to be detected in 76 hours of interplanetary flight.
	6. There was no change in the counting rate in the vicinity of the moon.

TABLE 3

U.S. Satellites Tentatively Planned for 1960

Project Title	Objectives and Description	Participants	Vehicle
Radiation Belt	Energetic particles studies including geographical distribution and temporal variations of the radiation belts.	GSFC[1] SuI[2] U. Minnesota	Delta 100 lbs 150-40,000 mi
Radiation Belt	Instruments to determine nature, intensity, and the variations with time of particles in Van Allen Radiation Belt.	SUI ABMA[3]	Juno II 22 lbs 150-35,000 mi
Ionospheric Properties	Determination of electron densities by means of ion probes. Satellite charging effects also will be studied.	GSFC	Juno II 50 lbs 135-600 mi
Ionosphere Beacon	Determination of ionospheric properties by analysis of data obtained by ground stations from reception of harmonically related signals transmitted by the satellite.	ABMA Stanford U. Illinois Penn State[4] CRPL, Boulder[5] U. of Alaska	Juno II 100 lbs 150-7,600 mi
Gamma Ray Astronomy	Detection of high energy gamma rays and mapping of distribution with respect to sun and our galaxy; correlation of distribution with cosmic ray flux density and density of interstellar matter in our galaxy.	MIT[6] U. of New Mexico	Juno II 100 lbs 135-600 mi
Solar Spectroscopy	Spectrophotometric study of the sun's corona and chromosphere in the ultraviolet and X-ray wavelengths; high resolution line spectroscopy in the ultraviolet	GSFC U. of Michigan U. of Colorado	Delta 350 lbs 300-600 mi

1 Goddard Space Flight Center
2 State University of Iowa
3 Army Ballistic Missile Agency
4 Pennsylvania State University
5 Central Radio Propagation Laboratory
6 Massachusetts Institute of Technology

TABLE 4

U. S. Space Probes Tentatively Scheduled for 1960

Objectives and Description	Participants	Vehicle
Directed generally inward toward the sun; measurements of communications techniques, tests of the use of solar cells, observations on the Van Allen Radiation Belt, cosmic rays, and the magnetic field.	U. of Chicago U. of Minnesota Stanford U. Space Technology Laboratories	Thor-Able
Measurement of interplanetary magnetic fields with rubidium vapor magnetometer, plus simultaneous observations of interplanetary plasmas.	Goddard Space Flight Center Massachusetts Institute of Technology	Thor-Delta
Determination of electron density profile up to at least one earth's radius.	Goddard Space Flight Center	Scout

TABLE 5

U. S. Sounding Rocket Experiments Tentatively Planned for 1960

Project	Number
Atmospheric Sounding	25
Synoptic Atmospheric Sounding	22
Ionospheric Sounding	13
Energetic Particles Sounding	18
Magnetic Field Sounding	7
Astronomy	36
Special	11
Total	132