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INTERNATIONAL CO-OPERATION IN THE PEACEFUL USES OF OUTER SPACE*

Report of the Committee on the Peaceful Uses of Outer Space

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* Item 26 of the provisional agenda.

REPORT OF THE COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE

I. INTRODUCTION

1. The Committee on the Peaceful Uses of Outer Space held its sixth session at United Nations Headquarters, New York, from 26 October to 6 November 1964, under the chairmanship of Mr. Franz Matsch (Austria). Mr. Mihail Haseganu (Romania) served as Vice-Chairman and Mr. Geraldo de Carvalho Silos (Brazil) as Rapporteur.
2. The Committee held eleven meetings, the records of which were circulated as documents A/AC.105/PV.25-35.
3. At its 26th meeting on 27 October, the Committee adopted the following agenda (A/AC.105/L.15):
 1. Opening statement by the Chairman.
 2. General debate.
 3. Report of the Scientific and Technical Sub-Committee (A/AC.105/20 and Add.1) on the work of its third session and the reports prepared by the International Telecommunication Union (A/AC.105/L.11) and the World Meteorological Organization (A/AC.105/L.10/Rev.1).
 4. Report of the scientific group established at the request of the Government of India to visit the rocket launching site at Thumba (A/AC.105/17).
 5. Report of the Legal Sub-Committee (A/AC.105/19 and A/AC.105/21 and Add.1) on the work of its third session.
 6. Report of the Committee to the General Assembly.
4. In addition to the documents listed in the agenda, the following documents, prepared in accordance with General Assembly resolution 1963 (XVIII) of 13 December 1963 and reviewed by the Scientific and Technical Sub-Committee at its third session, were submitted for the consideration of the Committee:
 - (a) Review of the activities and resources of the United Nations, of its specialized agencies and of other competent international bodies relating to the peaceful uses of outer space (A/AC.105/L.12);
 - (b) Review of national and co-operative international space activities (A/AC.105/L.13);

(c) List of sources of available bibliographies and abstracting services covering the scientific and technical results and publications in space and space related areas (A/AC.105/L.14).

5. Following an opening statement by the Chairman (see annex I), the Committee began its general debate. Statements were made by the representatives of Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Czechoslovakia, France, Hungary, India, Italy, Japan, Lebanon, Mexico, Poland, Romania, the Union of Soviet Socialist Republics, the United Arab Republic, the United Kingdom of Great Britain and Northern Ireland and the United States of America. The Committee also heard statements by the representatives of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Civil Aviation Organization (ICAO), the World Health Organization (WHO), the World Meteorological Organization (WMO) and the International Atomic Energy Agency (IAEA), who attended the session as observers. The statements are reported in the records of the 27th-31st meetings.

6. The Committee considered the remaining items on its agenda at its 32nd to 35th meetings. The Committee adopted its report to the General Assembly at its 35th meeting on 6 November 1964.

7. The recommendations and decisions of the Committee are set out below under the appropriate headings.

II. REPORT OF THE SCIENTIFIC AND TECHNICAL SUB-COMMITTEE AND
REPORTS PREPARED BY THE INTERNATIONAL TELECOMMUNICATION
UNION AND THE WORLD METEOROLOGICAL ORGANIZATION

8. The third session of the Scientific and Technical Sub-Committee was held at the European Office of the United Nations, Geneva, from 22 May to 5 June 1964 under the chairmanship of Mr. D.F. Martyn (Australia). The records of the Sub-Committee's meetings were circulated as documents A/AC.105/C.1/SR.21-26. The Sub-Committee's report was circulated as document A/AC.105/20 and Add.1.

9. On the completion of its consideration of the report of the Scientific and Technical Sub-Committee and the reports prepared by ITU (A/AC.105/L.11) and WMO (A/AC.105/L.10/Rev.1), the Committee approved the following:

Exchange of information

10. In each of its successive resolutions on international co-operation in the peaceful uses of outer space, the General Assembly has included provisions relating to the exchange and dissemination of information on outer space matters, the most specific being those contained in resolution 1721 (XVI) of 20 December 1961. In resolution 1721 B (XVI), the Assembly, after affirming its belief that the United Nations should provide a focal point for international co-operation in the peaceful exploration and use of outer space, recommended two measures to promote this objective: the maintenance of a public registry of data furnished to the Committee on the Peaceful Uses of Outer Space by States launching objects into orbit or beyond, and the organization of "the exchange of such information relating to outer space activities as Governments may supply on a voluntary basis, supplementing but not duplicating existing technical and scientific exchanges". These provisions were amplified by the Scientific and Technical Sub-Committee at its first session in May-June 1962 and the Sub-Committee's recommendations were subsequently endorsed by the Committee and later by the General Assembly in resolution 1802 (XVII) of 14 December 1962. Further recommendations made by the Sub-Committee at its second session in May 1963 were embodied by the Committee in its report to the General Assembly and endorsed by the latter in resolution 1963 (XVIII).

11. In accordance with the recommendations made by the Sub-Committee at its second session, the Secretariat prepared a summary of national and co-operative international space programmes based on the reports furnished in response to resolutions 1721 (XVI) and 1802 (XVII) and on information from other reliable sources. The Sub-Committee had also before it a paper on the space activities and resources of the United Nations, the specialized agencies and other competent bodies, as well as a paper giving a list of sources of available bibliographies and abstracting services covering the scientific and technical results and publications in space and space-related areas. The Sub-Committee examined with interest the three working papers prepared by the Secretariat and requested the Secretariat to update and correct them where necessary, including the addition of such further information as might be received through the voluntary assistance of Member States and competent international bodies, and to submit the papers, as revised, for consideration by the Committee on the Peaceful Uses of Outer Space. The revised papers were circulated as documents A/AC.105/L.12, A/AC.105/L.13 and A/AC.105/L.14 and were considered by the Committee.

12. The arrangements for the exchange of information so far put into effect have in general been welcomed. Nevertheless, in the light of experience it is clear that a number of steps could be taken to improve the exchange of information on the various aspects of the peaceful uses of outer space.

13. Recommendations of the Committee

A

The Committee on the Peaceful Uses of Outer Space,

Believing that the widest possible dissemination of information concerning the scientific and technical aspects of space exploration is conducive to the peaceful uses of outer space,

Requests the Secretary-General to continue to receive from international organizations, including regional bodies, information voluntarily submitted to the United Nations, to submit such information to the Scientific and Technical Sub-Committee, and then to compile such information in a suitable form to make it widely available.

B

The Committee on the Peaceful Uses of Outer Space,

Desiring that future reviews of rational and international co-operative space activities be such as to familiarize all United Nations Members with programmes in the application and use of outer space and with avenues open to Members for participation in this field,

1. Recommends that Member States be invited to continue to submit information annually on their activities in the peaceful uses of outer space, including information on programmes of international co-operation, the information to be submitted on a voluntary basis and in the form in which, in the view of the country submitting the information, it is likely to be of the greatest value to the readers for whom it is intended;

2. Decides to undertake, in co-operation with the Secretary-General and making full use of the functions and resources of the Secretariat, the preparation of a review every two years of national and international co-operative space activities and a summary providing a consolidated world-wide picture of international co-operation;

3. Recommends that such reviews, mentioned in paragraph 2 above, may include the following categories as guidelines:

(a) National organizations for space research;

(b) Manned space flight;

(c) Satellite programmes, including scientific satellites, international scientific satellites, meteorological satellites, and communication satellites;

(d) Lunar and planetary probes;

(e) Sounding rockets;

(f) Telemetry and data acquisition facilities;

(g) Space-related contributions to such programmes as the International Years of the Quiet Sun (IQSY) and the World Magnetic Survey (WMS);

(h) International co-operation;

(i) Related ground based activities.

C

The Committee on the Peaceful Uses of Outer Space,

1. Invites Member States conducting space activities to submit voluntarily literature on the goals, tools, results and application of space

research and technology of broad interest to Member States for inclusion in the library maintained by the Outer Space Affairs Group of the United Nations Secretariat;

2. Recommends that Member States be informed periodically of these acquisitions and their availability and that the library be supplemented periodically with brief, selected bibliographical listings of other new literature in this field.

D

The Committee on the Peaceful Uses of Outer Space,

1. Requests the Secretary-General, making full use of the functions and resources of the Secretariat and consulting as may be useful with the specialized agencies, to consider what material exists or may be needed to ensure popular understanding of the purposes and potentialities of space activities, the means by which new material might be made available, if required, the forms recommended, possibly as a series of pamphlets or a handbook, and an estimate of the costs involved, and to report his conclusions and recommendations to the Committee;

2. Requests the Secretary-General, making full use of the functions and resources of the Secretariat, to inquire of the Committee on Space Research (COSPAR) as to the status of its preparation of technical manuals to consider means by which the publication and distribution of this technical literature might be encouraged, and to report his findings, including specific conclusions and recommendations, to the Committee.

E

The Committee on the Peaceful Uses of Outer Space,

Calls the attention of Member States to the availability for research purposes by the scientists of Member States of the data obtained by rockets and satellites which exist in the World Data Centres in Moscow, Washington and Slough, England.

F

The Committee on the Peaceful Uses of Outer Space,

Requests the Secretary-General, making full use of the functions and resources of the Secretariat, to compile useful information on space conferences and symposia open to the scientists of Member States and to inform Member States periodically of such opportunities.

G

The Committee on the Peaceful Uses of Outer Space,

In view of General Assembly resolution 1472 (XIV) of 12 December 1959,

Decides to set up a working group composed of all members of the Committee to examine the desirability, organization and objectives of an international conference or meeting to be held in 1967 on the exploration and peaceful uses of outer space, as well as to make recommendations on the question relating to the participation in the said meeting of the appropriate international organizations; the working group shall report to the Committee at its next session.

Encouragement of international programmes

14. The importance of the areas of space communications and space meteorology has been recognized in past reports and recommendations of the Committee and its Scientific and Technical Sub-Committee.

15. In the field of space communications, the Committee on the Peaceful Uses of Outer Space, on the basis of the recommendations of the second session of the Scientific and Technical Sub-Committee, reiterated in its report to the General Assembly at its eighteenth session^{1/} that international space communications should be available for the use of all countries on a global non-discriminatory basis and recommended that all Member States take appropriate steps, using to the fullest extent the possibilities offered by the technical co-operation programmes, to develop and extend terrestrial communication systems in various parts of the world so that all Member States, regardless of the level of their economic, scientific and technological development, will be able to benefit from international space communications. The Committee also invited the specialized agencies and other competent international organizations to assist in the development and extension of such terrestrial systems.

16. In the course of the present session, the representative of Argentina informed the Committee that his Government is planning to establish a regional centre under international auspices for research and training in satellite communications systems. The Government of Argentina is also envisaging the possibility of submitting a request for assistance in this project to the United Nations Special Fund at the appropriate time.

^{1/} Official Records of the General Assembly, Eighteenth Session, Annexes, agenda item 28, documents A/5549 and Add.1.

17. The International Telecommunication Union convened an Extraordinary Administrative Radio Conference in October 1963 which allocated radio frequency bands for space radio communication purposes and revised such provisions of the International Radio Regulations as are essential for the effective implementation of its decisions.
18. The General Assembly at its eighteenth session adopted resolution 1963 (XVIII) in which it inter alia welcomed the decisions of the ITU Extraordinary Administrative Radio Conference and recognized the potential contribution of communications satellites in the expansion of global telecommunications facilities and the possibilities thus offered for increasing the flow of information and for furthering the objectives of the United Nations and its agencies.
19. In the field of space meteorology, there has been considerable interest in the establishment of the World Weather Watch. The Committee, on the basis of the recommendations of the Sub-Committee at its second session and the reports submitted by WMO, noted that in the programme on the research aspect of meteorological satellites, particular emphasis was placed on the need to establish a world weather watch, to develop meteorological observations from ground stations and to undertake research using information from meteorological satellites and conventional meteorological observations, and urged Member States to facilitate the development of extensive international co-operation in the establishment of the World Weather Watch, with particular emphasis on improving the world weather watch system and on the need for improved facilities for the exchange of data from meteorological satellites and conventional meteorological observations.
20. The progress report prepared by WMO, pursuant to General Assembly resolution 1963 (XVIII), drew attention to the meteorological programme of the International Years of the Quiet Sun, the implementation of the STRATWARM scheme, the assistance given to all geophysical sciences by carrying GEOALERT messages on the meteorological telecommunications network, and the increased efforts to foster research in the atmospheric sciences, particularly in the upper atmosphere.

21. Recommendations of the Committee

A

Scientific and technical

The Committee on the Peaceful Uses of Outer Space,

I

Noting with interest the development of several programmes of scientific and technical interest in the peaceful uses of outer space, such as:

- (a) The International Years of the Quiet Sun;
- (b) The International Indian Ocean Expedition;
- (c) The STRATWARM and other GEOALERT programmes;
- (d) The selected list of research projects in the field of atmospheric sciences worthy of particular attention as indicated by the Advisory Committee of the World Meteorological Organization (WMO);
- (e) The World Magnetic Survey;
- (f) International co-operative activities involving the reception of radio beacon transmission and continuous telemetering of signals from certain satellites, where available,

Draws the attention of Member States and the United Nations specialized agencies to these programmes and invites them to assist the international organizations concerned in the development of these programmes and related activities;

II

Noting with satisfaction the statements made at the third session of the Scientific and Technical Sub-Committee by the delegations of the Union of Soviet Socialist Republics and the United States of America on the reaching of a preliminary agreement between the scientists of the two countries to begin work on the joint preparation for publication of a review of achievements in, and prospects for, the development of space biology and medicine,

Further noting with satisfaction that arrangements are being made to obtain the advice of scientists of other countries,

Commends this joint effort which should prove to be of wide interest to the scientific community.

B

Applications

The Committee on the Peaceful Uses of Outer Space,

I

1. Notes with appreciation the progress reports submitted by the World Meteorological Organization (WMO) and the International Telecommunication Union (ITU) and requests these organizations to submit progress reports to the Committee in 1965;
2. Commends WMO for the further development of the World Weather Watch concept and its phased programme of action;
3. Commends ITU for the contribution made by it to the successful conduct of peaceful space activities through the effective results of the Extraordinary Administrative Radio Conference of 1963;
4. Calls to the attention of Member States the increasing measure of bilateral and multilateral co-operation in space projects which exemplify a way in which Member States, prepared to share in the responsibilities involved, may join effectively in specific international space programmes; these co-operative projects offer increasing opportunities for Member States to acquire useful information and training for the furtherance of their interests not only in international co-operation, but also in the development of space science and technology itself;
5. Notes with interest the growing co-operation between WMO and ICAO on the possible uses of information obtained by meteorological satellites for aeronautical purposes, and encourages Member States and the United Nations agencies concerned to give serious attention to this new field of peaceful space application;
6. Decides to consider questions relating to the use of satellites for transmitting radio and television programmes intended for direct reception by the general public after the report of the International Radio Consultative Committee (CCIR) on this subject has been received by ITU;
7. Invites the Secretary-General to call the attention of the Advisory Committee on the Application of Science and Technology to Development to the recommendations of and views expressed by the Committee on the subjects of space meteorology and space telecommunications;

II

Noting that there now exists the possibility of development of new communication techniques for radio navigation and traffic control, both at sea and in the air,

Invites the Scientific and Technical Sub-Committee, in co-operation with the Secretary-General and making full use of the functions and resources of the Secretariat and consulting as may be useful with the appropriate specialized agencies, to study and submit a report on the possibility of establishing a civil world-wide navigation satellite system on a non-discriminatory basis.

Education and training

22. The value of international co-operation in the field of education and training in space activities and its importance in achieving the common objective, which is to ensure that the exploration and use of outer space should be for the benefit of States, irrespective of their economic and scientific development, have been repeatedly affirmed in recommendations and resolutions of the General Assembly. In its report to the General Assembly at its eighteenth session, the Committee, on the basis of the report of the Scientific and Technical Sub-Committee, suggested the compilation, in co-operation with UNESCO and for circulation to Member States, of reviews of information on facilities for education and training in basic subjects related to the peaceful uses of outer space in universities and other places of learning. The Committee also invited attention to the importance of scholarships, fellowships and other means of technical assistance and invited Member States to give favourable consideration to requests of countries desirous of participating in the peaceful exploration of outer space, for appropriate training and technical assistance, on a bilateral basis or on any other basis they saw fit. The General Assembly, in resolution 1963 (XVIII), welcomed the compilation of reviews of information on facilities for education and training in basic subjects related to the peaceful uses of outer space in universities and other places of learning and also endorsed the invitation of the Committee to Member States to give favourable consideration to requests for appropriate training and technical assistance from countries desirous of participating in the peaceful exploration of outer space.
23. A paper containing a review of information on facilities for education and training in basic subjects related to the peaceful uses of outer space, compiled by the Secretariat of the Committee in co-operation with UNESCO, was submitted to the Sub-Committee at its third session and, after revision to bring the information contained as up to date as possible, was appended to the Sub-Committee's report as annex IV.

24. The Sub-Committee further took note of the fact that the question of education and training was also involved in the proposal, dealt with separately in its report, concerning International Sounding Rocket Launching Facilities, as the creation and use of these facilities under United Nations sponsorship would contribute to the furtherance of international collaboration in space research and the advancement of human knowledge and to the provision of opportunity for valuable practical training for interested users, as was noted by the General Assembly in resolution 1802 (XVII).

25. Recommendations of the Committee

A

The Committee on the Peaceful Uses of Outer Space,

Taking note of the working paper concerned with training needs, submitted by the United Kingdom of Great Britain and Northern Ireland at the second session of the Scientific and Technical Sub-Committee and since revised,

Further taking note of the review of information on facilities for education and training in basic subjects related to the peaceful uses of outer space, prepared by the Secretariat in co-operation with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and annexed to the Sub-Committee's report on the work of its third session,

Expressing its satisfaction that technical assistance and training is available under the auspices of both the World Meteorological Organization (WMO) and the International Telecommunication Union (ITU) for preparing interested Member States for participation in or the use of systems utilizing weather or communications satellites and encouraging the continuation of these activities,

Further expressing its satisfaction that a considerable number of Member States have supplied material for inclusion in the review of information on facilities for education and training referred to in the second preambular paragraph above,

Requests the Secretary-General, making full use of the functions and resources of the Secretariat, to continue his work for the compilation and updating of necessary material derived from governmental and other reliable sources in order to provide the Sub-Committee at its next session with ample information on facilities for education and training in basic subjects related to the peaceful uses of outer space.

/...

B

The Committee on the Peaceful Uses of Outer Space,

Recognizing the importance of scholarships, fellowships and other training opportunities in appropriate fields related to the exploration and the various peaceful uses of outer space to be put at the disposal of scientists in countries with comparatively limited resources in space research, especially developing countries, in order to enable them to acquire the knowledge and techniques necessary for fruitful participation in research and application in the domain of space exploration,

1. Invites Member States desirous of having their nationals take advantage of training to make their specific interests and needs known to the Secretary-General;

2. Invites Member States to continue to inform the Secretary-General of facilities for education and training and to include information on the availability of scholarships and fellowships, with specifications of the conditions and details thereof, in appropriate fields related to the exploration and the various peaceful uses of outer space;

3. Requests the Secretary-General, when the necessary information and data are available and making full use of the functions and resources of the Secretariat, to make an appropriate dissemination of such information, and that this be done on a continuing basis.

International sounding rocket launching facilities

26. At its second session, the Scientific and Technical Sub-Committee commended the initiative taken by the Government of India in establishing the equatorial sounding rocket launching site at Thumba and recommended to the Committee the approval of the establishment, at the request of the Government of India, of a group of scientists, drawn from States members of the Committee and familiar with space research activities and facilities, to visit the station when it was fully operative and to advise the Committee on the acceptance of United Nations sponsorship in accordance with the basic principles approved by the Committee in its 1962 report.^{2/} The Committee endorsed the Sub-Committee's recommendation and the General Assembly in resolution 1963 (XVIII) welcomed this step.

^{2/} Ibid., Seventeenth Session, Annexes, agenda item 27, document A/5181.

27. The scientific group visited Thumba in January 1964 and in its report to the Committee (A/AC.105/17) recommended that United Nations sponsorship be granted to India for the continuing operation of the Thumba International Equatorial Sounding Rocket Launching Facility.

28. The Sub-Committee took note of the steps reported by the representative of India to establish an advisory panel consisting of scientific representatives of user States by inviting each of the countries which had taken major interest in creating the facilities at Thumba to nominate one representative. An informal meeting of representatives of France, India, the Union of Soviet Socialist Republics and the United States of America had been held. Discussions were in progress with other States interested in research at the magnetic equator and it was hoped to enlarge the advisory panel.

29. At its second session, the Sub-Committee, in the light of statements made by various representatives and of informal discussions about the possible value of international sounding rocket launching facilities at equatorial and other appropriate locations, recommended that the Committee on the Peaceful Uses of Outer Space should invite COSPAR to review the geographic distribution of sounding rocket launching facilities and their capabilities on the basis of information about them given on a voluntary basis, and advise the Sub-Committee from time to time on desirable locations and important topics of research, taking into account the need to avoid duplication of effort. The Committee on the Peaceful Uses of Outer Space accepted the recommendations of the Sub-Committee and invited COSPAR to take the necessary action.

30. In the course of the Committee's third session, the Brazilian delegation indicated the intention of its Government to request, in accordance with General Assembly resolution 1802 (XVII), United Nations sponsorship for the sounding rocket launching facilities that are being established near Natal in the northeast of Brazil.

31. Recommendations of the Committee

The Committee on the Peaceful Uses of Outer Space,

A

Recalling General Assembly resolution 1963 (XVIII) of 13 December 1963, which welcomed the decision of the Committee on the Peaceful Uses of Outer Space to undertake the establishment, at the request of the Government of India, of a group of scientists to visit the sounding rocket launching

facility at Thumba and to advise the Committee on its eligibility for United Nations sponsorship in accordance with the basic principles endorsed by General Assembly resolution 1802 (XVII) of 14 December 1962,

Taking note of the report of the scientific group which visited the rocket launching site at Thumba in January 1964 (A/AC.105/17),

Further taking note of the action by India, reported in the statement before the Sub-Committee, that, in accordance with General Assembly resolution 1802 (XVII), a scientific advisory panel consisting of representatives of nations involved in a substantial manner in the creation of the Thumba Equatorial Rocket Launching Station (TERIS) has already been constituted by the host State,

1. Endorses the recommendation of the scientific group that United Nations sponsorship be granted to India for the continuing operation of the Thumba International Equatorial Sounding Rocket Launching Facility;

2. Urges that due attention should be paid by the United Nations, the specialized agencies and Member countries to requests received from the host State and endorsed by the scientific advisory panel for assistance to:

(a) Undertake measures to increase the utility of TERIS as a place for international collaboration in sounding rocket experimentation;

(b) Provide programmes and facilities, including fellowships, at TERIS for training scientists and technicians, especially from countries with comparatively limited resources in space research and from developing countries, in the following activities, to the extent that such training may be effectively utilized at TERIS or elsewhere:

- (i) Range operations;
- (ii) Payload design, construction and testing;
- (iii) Data processing and analysis related to sounding rocket experimentation;
- (iv) Ground-based experiments and facilities;

3. Advises the host State that, in making the annual reports required of it under General Assembly resolution 1802 (XVII), it may call upon the Secretariat for assistance, if it so wishes.

B

The Committee on the Peaceful Uses of Outer Space,

Recalling its earlier invitation to COSPAR to review the geographic distribution of sounding rocket launching facilities and their capabilities from information about them given on a voluntary basis, and to advise the Sub-Committee from time to time on desirable locations and important topics of research, taking into account the need to avoid duplication of effort;

Renews the above-mentioned invitation.

Potentially harmful effects of space experiments

32. The question of the potentially harmful effects of space experiments has been considered at successive meetings of the Scientific and Technical Sub-Committee and the Committee. In its last report to the General Assembly, ^{3/} the Committee recognized the importance of the problem of preventing potentially harmful interference with peaceful uses of outer space.

24. The Sub-Committee had before it the resolution, adopted by the Executive Council of COSPAR in May 1964 on the basis of the report of the Consultative Group, in which COSPAR made specific proposals concerning space experiments which might involve potentially harmful effects.

33. Recommendations of the Committee

The Committee on the Peaceful Uses of Outer Space,

Recalling paragraph 18 of its report to the General Assembly at its eighteenth session, ^{3/}

Taking note of paragraph 6 of General Assembly resolution 1962 (XVIII) of 13 December 1963, declaring legal principles governing the activities of States in the exploration and use of outer space,

Recognizing the role and the competence of the COSPAR Consultative Group on Potentially Harmful Effects of Space Experiments,

1. Takes note of the resolution adopted by COSPAR at its seventh session held in May 1964 on the basis of the report of the Consultative Group;

2. Requests the Secretary-General to circulate to Member States the resolution of COSPAR, ^{4/} the report of the Consultative Group and its four appendices, all of which are annexed to the present report; ^{5/}

3. Urges that all Member States proposing to carry out experiments in space should give full consideration to the problem of possible interference with other peaceful uses of outer space, as well as of possible harmful changes in the natural environment caused by space activities and, where Member States consider it appropriate, should seek a scientific analysis of

^{3/} Ibid., Eighteenth Session, Annexes, agenda item 28, document A/5549.

^{4/} See annex II.

^{5/} See annex III.

the qualitative and quantitative aspects of those experiments from the COSPAR Consultative Group on Potentially Harmful Effects of Space Experiments, and should give due consideration to the results of this analysis; this does not preclude other recourse to international consultations as provided for in General Assembly resolution 1962 (XVIII);

4. Invites COSPAR to inform the Committee of the results of any analysis carried out by the COSPAR Consultative Group, which may be considered by the COSPAR Executive Council to be appropriate for dissemination.

General

34. Recommendation of the Committee

The Committee on the Peaceful Uses of Outer Space

I

1. Commends the Secretary-General and particularly the Outer Space Affairs Group of the United Nations Secretariat for their preparation of draft reviews on activities and resources of various international organizations and bodies relating to the peaceful uses of outer space, on national and international co-operative space activities, on bibliographies and abstracting services and on education and training;

2. Decides, in co-operation with the Secretary-General and making full use of the functions and resources of the Secretariat, to update and republish the reviews mentioned in paragraph 1 above at least every two years;

II

Desirous of responding to those Member States which are not members of the Committee on the Peaceful Uses of Outer Space and wish to be more fully informed regarding outer space matters and the work of the United Nations and its specialized agencies in this area,

Draws attention to the records of the proceedings of the Committee and of its Scientific and Technical Sub-Committees and to the reports of the specialized agencies, which have been circulated as documents A/AC.105/FV.25-35, A/AC.105/SR.21-26, A/AC.105/L.11 and A/AC.105/L.10/Rev.1.

III. REPORTS OF THE LEGAL SUB-COMMITTEE ON THE WORK OF ITS THIRD SESSION

35. The third session of the Legal Sub-Committee of the Committee on the Peaceful Uses of Outer Space was convened at the European Office of the United Nations, Geneva, on 9 March 1964 under the chairmanship of Mr. Manfred Lachs (Poland). The first part of the session was concluded on 26 March. The second part of the session was convened at United Nations Headquarters, New York, on 5 October and concluded on 23 October 1964. The records of the Sub-Committee meetings were circulated as documents A/AC.105/C.2/SR.29-40. The reports of the Sub-Committee were circulated as documents A/AC.105/19 and A/AC.105/21 and Add.1.
36. The Sub-Committee's terms of reference were set out in section I of General Assembly resolution 1963 (XVIII), as follows:

"The General Assembly,

"...

"1. Recommends that consideration should be given to incorporating in international agreement form, in the future as appropriate, legal principles governing the activities of States in the exploration and use of outer space;

"2. Requests the Committee on the Peaceful Uses of Outer Space to continue to study and report on legal problems which may arise in the exploration and use of outer space, and in particular to arrange for the prompt preparation of draft international agreements on liability for damage caused by objects launched into outer space and on assistance to and return of astronauts and space vehicles;

"3. Further requests the Committee on the Peaceful Uses of Outer Space to report to the General Assembly at its nineteenth session on the results achieved in preparing these two agreements."

37. In its report on the second part of the session, the Sub-Committee took note of the preliminary agreement reached in an informal working party on the preamble, articles 2, 3, 6 (1), (3), (4), and (5), of a convention on assistance and return,^{6/} with the exception of the place where article 3 (2) would appear in the convention. The Sub-Committee noted further that a working group of the Sub-Committee completed the first reading of the article of draft agreements on liability for damage caused by objects launched into outer space. The Sub-Committee recommended that further work on the two conventions should be continued at its next session.

^{6/} The text of the preamble and the respective articles are reproduced in annex III of the Sub-Committee's report on the second part of its third session (A/AC.105/21 and Add.1).

38. The Committee notes with satisfaction that substantial progress was made in the course of the Sub-Committee's third session, although there was insufficient time to draft the international agreements, and decides that work on the two conventions should be resumed as soon as possible.

IV. REGISTRATION

39. In conformity with the provisions of paragraphs 1 and 2 of General Assembly resolution 1721 B (XVI), the Committee has continued to receive information from the USSR and from the United States concerning objects launched into outer space. The information received since the Committee's last report has been placed in the public registry maintained by the Secretary-General in accordance with resolution 1721 B (XVI) and has been circulated in documents A/AC.105/INF.45-82.

ANNEX I

Opening statement by the Chairman, made at the 26th meeting
of the Committee, on 27 October 1964

In opening the sixth session of our Committee, I should like to recall the agreement reached at our first session in March 1962, an agreement observed at subsequent sessions, that it would be the aim of all members of the Committee to conduct the Committee's work in such a way that it would be able to reach agreement in its work without the need to vote. I trust that the members of the Committee will agree to continue this procedure at our present session.

Since our Committee's last meeting in November 1963, the organization of the Committee's and Sub-Committee's programme of work during the present year in the light of the General Assembly's resolutions 1962 (XVIII) and 1963 (XVIII) was agreed upon through informal consultations conducted by the Bureau of the Committee with all other members of the Committee in February and May, and reported in documents A/AC.105/16 and addendum 1.

In the past year, the Committee has continued to receive information from the Union of Soviet Socialist Republics and the United States concerning objects launched into orbit or beyond for registration by the Secretary-General as provided for in resolution 1721 (XVI) of the General Assembly. The members of the Committee have received the report of the Scientific and Technical Sub-Committee, document A/AC.105/20 and Add.1, the report of the scientific group on the visit to the launching site at Thumba, document A/AC.105/17, the third report of the International Telecommunication Union, document A/AC.105/L.11, and the report of the World Meteorological Organization, document A/AC.105/L.10/Rev.1, and, finally, the report of the Legal Sub-Committee, document A/AC.105/19 and A/AC.105/21.

The Committee also has before it three working papers prepared by the Secretariat, a summary of national and co-operative international space programmes, a report on the space activities and resources of the United Nations, the specialized agencies and other competent bodies, and a list of sources of bibliographies and abstracting services covering scientific and technical publications in space-related areas. At the request of the Scientific and Technical Sub-Committee, the papers have been up-dated and corrected where necessary, and submitted for consideration by the Committee.

The report of the Scientific and Technical Sub-Committee contains recommendations within the terms of reference established by the resolutions of the General Assembly, and refers to measures to be taken to improve international co-operation and co-ordination in the peaceful exploration and uses of outer space. These recommendations cover five general topics.

Firstly, with regard to exchange of information, the Secretary-General would continue to receive information voluntarily submitted by international organizations concerning the scientific and technical aspects of space exploration, and then compile such information in order and in a suitable form to make it widely available. In order to familiarize all United Nations Members with the programmes in the application and use of outer space and with avenues open to Members for participation in this field, Member States would be invited to continue to submit voluntarily annual information on outer space activities, including information on programmes of international co-operation. This information on national and international co-operative space activities would be published in a biannual review and in a summary which would provide a consolidated, global picture of international co-operation. Member States conducting space activities would be requested to submit voluntarily literature on space research and technology for inclusion in an outer space library of the Outer Space Affairs Group of the Secretariat. Member States would be periodically informed of new acquisitions.

As recommended by the Scientific and Technical Sub-Committee, the Secretary-General would be invited to consider what material exists or may be needed to ensure popular understanding in the purposes and potentialities of space activities, and the means by which new material may be available, possibly by pamphlets or a handbook, and to report his suggestions to the Sub-Committee.

The Secretary-General would also be requested to consider means by which the publication and distribution of technical annuals prepared by COSPAR might be encouraged.

The Sub-Committee also draws attention to the fact that outer space research data obtained by rockets and satellites are available to scientists of Member States through the World Data Centres in Moscow, Washington and Slough in England.

The Secretary-General would also compile information on space conferences and symposia open to scientists of Member States and would inform Member States of such opportunities.

Finally, the Sub-Committee recommended that consideration be given to the usefulness of organizing an international conference in 1967 on the exploration and peaceful uses of outer space.

Secondly, as regards encouragement of international programmes, in the field of space communication, the Scientific Sub-Committee, under the able chairmanship of Dr. Martyn of Australia, recalled the view stated in our Committee's report to the eighteenth session of the General Assembly that international space communications should be available for the use of all countries on a global and non-discriminatory basis and the recommendation that all Member States take appropriate steps, using to the fullest extent the possibilities offered by the technical co-operation programmes, to develop and extend terrestrial communication systems in various parts of the world so that all Member States, regardless of the level of their economic, scientific and technological development, will be able to benefit from international space communications.

The Third Progress Report of ITU describes the further concrete steps that have been taken by ITU in this field. The Extraordinary Administrative Radio Conference in October 1963 allocated radio frequency bands for the purpose of communication satellites, meteorological satellites, telemetry and tracking, navigation satellites, radio astronomy, space research and space vehicles in distress and for aeronautical purposes. The Plan Committee of ITU has given attention to a preliminary survey of problems arising from world communication satellites with special relevance to short-term, until 1968, and to long-term global traffic, up to 1975. The ITU Administrative Council has been invited to take steps to help the developing countries in order that these countries may participate effectively in international space communication systems and integrate these systems with their national telecommunication networks.

In the field of space meteorology emphasis has continued to be placed on the need to establish a world weather watch, to develop meteorological observations from ground stations and to undertake research using information from meteorological

satellites and conventional meteorological observations. Member States have been urged to facilitate the development of extensive international co-operation in the establishment of the World Weather Watch, with particular emphasis on improving the world weather watch system and on the need for improved facilities for the exchange of data from meteorological satellites and conventional meteorological observations.

The progress Report of WMO draws attention to the fact that information received from weather satellites continued to be made available under arrangements notified by WMO to all countries of the world.

Particularly satisfactory is the assurance given in the WMO Report that since the fourth WMO Congress in 1963 good progress has been made towards implementation of a phased programme of action for establishing the concept of World Weather Watch as an ultimate world weather service and of related research projects.

The Scientific Sub-Committee also mentions the development of several programmes of scientific and technical interest in the peaceful uses of outer space, including the International Years of the Quiet Sun, the International Indian Ocean Expedition and the World Magnetic Survey and others.

The preliminary agreement reached between Soviet and American scientists in May 1964 to begin work on a joint publication of a review of achievements in and prospects for the development of space biology and medicine was noted with satisfaction. The Sub-Committee notes that arrangements are being made to obtain the advice of scientists of other countries on these subjects.

The attention of Member States is called to the increasing measure of bilateral and multilateral co-operation in space projects which exemplify a way in which Member States, prepared to share in the responsibilities involved, may join effectively in specific international space programmes. These co-operative projects offer increasing opportunities for Member States to acquire useful information and training for the furtherance of their interests not only in international co-operation, but also in the development of space science and technology itself.

Thirdly, as regards education and training, the value of international co-operation in this field has been affirmed in past resolutions of the General Assembly. Many Member States have supplied information on education and training

facilities in basic subjects related to peaceful uses of outer space and on the availability of scholarships and training opportunities. The information furnished is reproduced in Addendum 1 to the Scientific Sub-Committee's report. Similar compilations by the Secretariat are to be disseminated on a continuing basis. Member States are invited to make known their specific interests and needs to train their nationals.

Fourthly, concerning international sounding rocket launching facilities, in accordance with General Assembly resolution 1963 (XVIII) a scientific group visited the Thumba equatorial sounding rocket launching site and recommended in its report (A/AC.105/17) that United Nations sponsorship be granted to India for this site in conformity with the basic principles endorsed by the General Assembly in resolution 1802 (XVII). The Scientific Sub-Committee recommends that the General Assembly endorse the recommendation that United Nations sponsorship be given to India for continuing operation of the Thumba site and that due attention be paid by the United Nations to a request from the host State for assistance to increase the utility of the site as a place for international collaboration in sounding rocket experiments.

I should like also to draw the attention of this Committee to the additional detailed information furnished by the Italian representative in the Scientific Sub-Committee on the San Marco mobile sea-based launching platform as an interesting example of how a mobile range of the San Marco type can stimulate peaceful scientific relations with developing countries. Information on this co-operation between Italy and Kenya was circulated as document A/AC.105/18.

Fifthly, as regards potentially harmful effects of space experiments, on the basis of a COSPAR report Member States proposing to carry out experiments in outer space should give full consideration to the problem of possible interference with other peaceful uses of outer space as well as of possible harmful changes in the natural environment caused by space activities and should seek a scientific analysis of those experiments from COSPAR's special Consultative Group or by other international consultations. The report of the COSPAR Consultative Group would be circulated to all Member States.

For the first time since the United Nations has been dealing with outer-space matters, reference has been made in the Scientific Sub-Committee's report to a COSPAR resolution of 20 May 1964, affirming that the search for extra-terrestrial life is an important objective of outer-space research.

As to the work of the Legal Sub-Committee this year, the third session of that Sub-Committee, which was characterized by an atmosphere of co-operation, was held in two parts: one in March in Geneva, the other here in New York in October. After general debate within the framework of General Assembly resolution 1963 (XVIII), the Legal Sub-Committee and its two working groups concentrated their efforts on the elaboration of a draft international agreement on assistance to and return of astronauts and space vehicles, and on a draft international agreement on liability for damage caused by objects launched into outer space.

With regard to the question of assistance to and return of astronauts in space vehicles, the Sub-Committee had before it three proposals; one by the USSR, one by the United States, and the third submitted jointly by Australia and Canada. In the course of the discussions many amendments were presented. The Sub-Committee did useful work in clarifying the positions involved. It was able to narrow the gap and to reach agreement on several articles of such an international convention. The report of the Legal Sub-Committee reflects the development of this draft agreement.

On the subject of liability for damage caused by objects launched into outer space, the Sub-Committee had before it in Geneva a draft agreement submitted by Hungary, a draft convention submitted by the United States, and a working paper submitted by Belgium. At the second part of its third session in New York the Sub-Committee had before it, in addition to the draft agreement submitted by Hungary, a revised draft convention submitted by the United States and a draft convention submitted by Belgium. What could be called a first reading of the three texts was completed and views were expressed on a number of problems essential to the preparation of a convention on liability. This included such matters as the States which should be made liable for damage caused by space objects; the principle of absolute liability for damage or, in other words, that the party causing the damage should be liable irrespective of whether it or the other

party was at fault; the extent of liability where more than one State was determined to be liable for the damage; the question of the period within which claims should be presented, and whether liability should be subject to a limitation in amount or should be unlimited. All these problems are rather complicated and require careful consideration.

The Sub-Committee recommended continuation of its work, under the able chairmanship of Professor Lachs of Poland, on both draft agreements on assistance and liability at its next session in 1965, and with the Committee's endorsement this course will be followed.

This resumé would not be complete without mentioning the fact that since the Committee's last session great progress has been achieved in the penetration of outer space. Among other achievements, the first close-up picture of the moon's surface and the recent first three astronauts' space-craft flight were universally recognized as outstanding results.

It is no exaggeration to say that research and exploration of outer space for peaceful uses will have profound effects on the development of the countries and peoples of the world. Man's entry into outer space commands universal interest and marks a new era for mankind.

ANNEX II

RESOLUTION ADOPTED BY THE EXECUTIVE COUNCIL OF THE COMMITTEE ON
SPACE RESEARCH (COSPAR) ON 20 MAY 1964

The Committee on Space Research (COSPAR)

Noting with appreciation and interest the extensive work done by the Consultative Group on Potentially Harmful Effects of Space Experiments as expressed by the Group in its report and annexes,

1. Instructs its Secretariat to make this report and annexes available to ICSU, the adhering bodies of COSPAR and other interested parties;
2. Welcomes the encouraging conclusions of the Consultative Group that harmful contamination of the upper atmosphere on a long-term global basis is unlikely on present and expected scale of firings of super rockets and the release of experimental seeding. COSPAR urges its adhering organizations to report any major new experiments which may produce harmful contamination. Moreover, it urges them to encourage these scientists to continue studies of the following matters:

- (a) Evaluation of exchange times between the various regions of the upper atmosphere, especially between 60 and 100 km,
- (b) Short and long term local and zonal effects of rocket contamination in the upper atmosphere,
- (c) The possibility of any catalytic effects which might trigger chemical and photochemical processes in the upper atmosphere, and
- (d) Radiation balance in the upper atmosphere and its dependence on changes in composition there;

3. Welcomes the conclusion of the Consultative Group that no interference to optical and/or radio astronomy has resulted from the belt of orbiting dipoles launched in May 1963, and recommends to its members that any proposals for future experiments of this sort also be given the benefit of thorough evaluation by the scientific community and notably by the International Astronomical Union, in order to check in advance their harmlessness to other scientific research.

4. Affirms that the search for extraterrestrial life is an important objective of space research, that the planet Mars may offer the only feasible opportunity to conduct this search during the foreseeable future, that contamination of this planet would make such a search far more difficult and possibly even prevent for all time an unequivocal result, that all practical steps should be taken to ensure that Mars be not biologically contaminated until such time as this search can have been satisfactorily carried out, and that co-operation in proper scheduling of experiments and in use of adequate spacecraft sterilization techniques is required on the part of all deep space probe launching authorities to avoid such contamination;
5. Accepts, as tentatively recommended interim objectives, a sterilization level such that the probability of a single viable organism aboard any spacecraft intended for planetary landing or atmospheric penetration would be less than 1×10^{-4} , and a probability limit for accidental planetary impact by unsterilized fly-by or orbiting spacecraft of 3×10^{-5} or less;
6. Calls attention to the opinion of its Consultative Group that although less rigorous sterilization techniques are required for lunar landings, because the lunar surface conditions would almost certainly exclude microbial replication, it is desirable that drills designed for deep lunar subsurface boring should be very carefully sterilized to avoid contamination of regions below the surface where a more favourable environment might exist;
7. Calls on its members that are concerned with planetary probes to urge the vehicle construction and launching authorities in their countries to try to achieve these sterilization objectives and especially to forego the launching of planetary atmospheric entry and lander vehicles until such time as the above-mentioned level of sterility can be achieved with a high degree of certainty;
8. Requests its members concerned with planetary probes to report to COSPAR any disagreement or objections they may have to use of these tentative objectives or to any other aspects of appendix 4 of the Consultative Group report, and expresses the hope that the Consultative Group will arrange continued studies in the area of biological contamination of the moon and planets, taking into account any such reports or comments as may be received; and finally,

9. Authorizes the Consultative Group in consultation with the Chairman of Working Group V to arrange for the convening of an international conference on biological sterilization and sterility testing techniques at any time and place and in co-operation with any other scientific organizations it may deem appropriate, provided it can be assured in advance of substantial participation in the conference by scientists of both the major deep space probe launching authorities.

ANNEX III

REPORT TO THE EXECUTIVE COUNCIL OF THE COMMITTEE ON SPACE
RESEARCH (COSPAR) OF THE COSPAR CONSULTATIVE GROUP ON
POTENTIALLY HARMFUL EFFECTS OF SPACE EXPERIMENTS

(May 1964)

1. The Consultative Group was formed in January 1963 with the following composition: V. Sarabhai (Chairman), C.G. Heden, H.C. van de Hulst, W.W. Kellogg, G.A. Ratcliffe, G.A. Savenko, V.V. Vitkevitch.
2. The Group was created in response to the following resolution of the Executive Council of COSPAR:

"In order to carry out the responsibility for careful, objective, quantitative studies of space experiments with potentially undesirable effects on scientific activities and observations, which COSPAR has accepted in response to ICSU resolution 10 (1961) (COSPAR Doc./62/11), the Executive Council decides to establish a Consultative Group on Potentially Harmful Effects of Space Experiments, to consist of not more than six broadly competent scientists having among them specialized knowledge of Astronomy, Radiation Physics and Chemistry, Communications, Meteorite Penetration and Microbiology, to be named by the President of COSPAR.

"It is expected that this Consultative Group will act as a focal point in ICSU for consideration of all questions regarding potentially harmful effects of space experiments on scientific activities and observations, and that in this capacity it would (1) examine in a preliminary way all questions relating to possibly harmful effects of proposed space experiments, including but not restricted to questions referred to it by any of the ICSU Unions; (2) determine whether or not any serious possibility of harmful effects would indeed result from the proposed experiment; (3) in consultation with appropriate Unions, appoint and arrange for convening an ad hoc Working Group or Groups to study any expected effects which are considered to be potentially harmful, such Working Group or Groups to include competent scientists in the appropriate specialized disciplines; (4) receive and consider conclusions or recommendations of these ad hoc Working Groups in a timely manner; and (5) prepare final recommendations to the COSPAR Executive Council for its further action.

"Positive or negative recommendations or studies considered appropriate by the Council for dissemination would then be made available to all COSPAR adherents, the ICSU Bureau, the appropriate Unions of ICSU, and to appropriate bodies of the United Nations or its specialized agencies."

3. The Group has met in: Paris - March 1963, Warsaw - June 1963, Geneva - February 1964 and Florence - May 1964.

In a preliminary report submitted by COSPAR at Warsaw in June 1963, it was stated that the Group was initially concerning itself with the following topics: (a) Pollution of the Upper Atmosphere, (b) Orbiting Dipoles, (c) Contamination of the Moon and Planets. The present report gives the current status of the studies on each topic. Appendices incorporate statements by the Group on those topics for which the Group feels it is appropriate to do so at the present time.

4. The Group has approached its task broadly as follows. It has discussed and attempted to identify the scientific questions involved in each problem by studying existing literature. Where the literature has been available in widely scattered sources, as in the problem of contamination of planets, the Group has arranged for a compilation of the literature to facilitate its evaluation.

At times an individual member of the Group has critically examined current scientific information and prepared his own report which has been used for stimulating further comments and discussions.

The Group has then consulted individual scientists and scientific groups. Where discrepancies or divergent opinions have emerged, the Group has attempted to bring together the specialists concerned in order to resolve differences if possible, or at least to evolve a consensus and a clarification for further studies.

In attempting quantitative evaluation of potentially harmful effects the Group has thus relied heavily on assistance of scientists and scientific organizations.

5. The present status of the studies can be summarized as follows:

(a) Pollution of the Upper Atmosphere

A statement by the Group is enclosed as appendix 1. It gives an evaluation of likely consequences to environmental conditions of the firing of a relatively large number of super rockets per year and of the extensive use of chemical tracers in the upper atmosphere. It also indicates the uncertainties in our present knowledge, and the need for further quantitative studies.

(b) Orbiting Dipoles

A statement by the Group is enclosed as appendix 2. It represents agreed views of leading specialists in the field providing a basis for quantitative evaluation of the consequences of a dipole belt of given characteristics of radio and optical astronomy.

(c) Contamination of the Moon and Planets

The Group decided at its meeting in February 1964 that a statement as reproduced in appendix 3 be immediately communicated to COSPAR on behalf of the Group. This points out the extreme importance of undertaking, for the time being, only fly-by missions for the study of Mars.

Following the compilation of available literature on the subject, a Panel of the following specialists has met in Florence during the COSPAR Symposium in May 1964.

Members: Prof. A. Brown, Dept. of Biology, Univ. of Pennsylvania
Prof. A. Dollfus, Astrophysics Section, Paris Observatory
Prof. M. Florkin, Biochemical Laboratory, University of Liège
Dr. L. Hall, Bioscience Programmes NASA
Acad. A.A. Imshenetskii, Inst. of Microbiology, USSR Academy of Sciences
Prof. C. Sagan, Harvard College Observatory (Rapporteur)
Dr. P.H.A. Sneath, British Medical Research Council
- Additional Russian member (not present)
Prof. C.G. Heden (Convenor)

The Panel has discussed the standards of sterilization which can be recommended for the protection of possible life on Mars. Its report is enclosed in appendix 4.

The Group has considered the report of the Panel and in relation to its statement contained in appendix 3 invites special attention to remarks concerning the danger of contamination through accidental landings of fly-by missions and the definitive steps suggested to reduce this danger.

The Group urges continued efforts for the improvement of sterilization techniques and full sharing of information concerning procedures designed to achieve spacecraft with the required level of sterility.

The Group recommends early action to declare Mars a biological preserve to ensure that in the exploration of this planet, considerations of biological research receive priority over others.

The Group recommends the proposal for convening an international conference in early 1965 to consider the technology of sterilization and sterilization testing.

6. In concluding the present report, the Group wishes to thank the scientists and scientific organizations who have made possible the studies which have been undertaken.

Appendix 1

Statement on Upper Atmospheric Pollution by Rocket Exhaust
and Chemical Injection Experiments

by the COSPAR Consultative Group

on

Potentially Harmful Effects of Space Experiments

(16 May 1964)

1. Interest and concern about the possible effects of space experiments, particularly those involving large rockets or the repeated injection of metallic vapors, on the composition and structure of the Earth's atmosphere had been occasionally expressed before COSPAR decided to set up its Consultative Group on Potentially Harmful Effects of Space Experiments (May 1962). A request to COSPAR by the ICSU Executive Board in October 1962 (Resolution EB XIV 27) suggested a study of this topic. However, the publicity given to a report (part of a series) on rocket pollution of the upper atmosphere by J. Pressman, W. Reidy, and W. Lank (Institute of Aerospace Science, January 1963) created a certain amount of public concern. Hence, this problem was selected at once by the Consultative Group as deserving further study.
2. The COSPAR Consultative Group has been instructed by its Charter "to arrange for careful quantitative studies" of the problems referred to it, in order that the conclusions of such studies may be available to all concerned. The arrangements in the present case were as follows: Copies of the Pressman report were obtained and W.W. Kellogg, a member of the Consultative Group, was asked to prepare an independent report, reviewing the general question in as quantitative a way as possible. The two reports, which arrived in part at rather different conclusions, were then submitted to a number of experts in the world with a request for criticism and comments. The comments received from twenty experts in six countries (Belgium, Germany, India, Netherlands, United Kingdom, USA) were reviewed at a meeting of the Consultative Group in February 1964. A second version of Kellogg's report, taking these comments into account, will be published in an international scientific journal and reprints will be available from the COSPAR Secretariat.

3. While there was not absolute unanimity in the views of the experts who volunteered comments, the following is believed by the Consultative Group to be a fair consensus of the situation as it is now understood.

There are a variety of ways in which man can alter the conditions in the upper atmosphere, and the degree of such alteration can obviously vary over a wide range. Some such effects are merely detectable, and are probably not "potentially harmful", while there are other changes that cause interference with future experiments or that can be considered as harmful in other ways. In order to discuss the vastly different effects that could be caused by injections of chemicals into the upper atmosphere, it has been convenient to distinguish between four classes of effects which are:

- (a) a harmless, short-term and localized alteration of the upper atmosphere that can be readily observed at the ground;
- (b) a long-term and world-wide alteration of the observable characteristics of the upper atmosphere, but one which causes no identifiable interference or harmful effect;
- (c) an extensive alteration of the upper atmosphere that interferes with scientific experiments or other human activities;
- (d) an atmospheric alteration that affects man's environment.

4. It appears that there are many instances where (a) has occurred. For example, local effects of the passage of a large rocket through the upper atmosphere can be observed visually, especially at twilight when it may leave a bright trail, and perturbations of the ionosphere by large rockets, detectable by radio means, have been observed repeatedly; none of these more or less localized phenomena have been judged as "harmful". On the other hand (b) has not occurred, with the possible exception of the reported instances where the lithium content of the upper atmosphere may have been affected on a world-wide basis for a few months in 1962 by man-made injections. There has not been an instance of (c) as far as chemical injections are concerned, but the world-wide background of some radioactive tracers (tritium, carbon-14, etc.) has been changed by repeated injections, and this has interfered with certain studies of circulation and exchange rates between regions of the atmosphere. Case (d) has not occurred, and seems most unlikely. The reasons for this opinion are outlined in part in the next paragraphs.

5. In order for the atmosphere to be so changed that the environment of life is affected - case (d) - the pollution of the upper atmosphere would surely have to be very extensive, and so we must distinguish between long-term and short-term pollutants, and concentrate on the former. If at a certain injection rate a pollutant builds up a concentration exceeding a specified value in a relevant region, we refer to it as a long-term pollutant. It is obvious that the specified limiting value must differ with different pollutants, and also for the same pollutant with reference to different effects.

A world-wide, long-term change of the background concentration of some atmospheric constituent that would be just detectable might be 10 per cent or less for a relatively well mixed and permanent gas (e.g. CO_2 , CH_4), and it might be by a factor of two or three for constituents that vary a great deal naturally (e.g. H_2O , NO , Li). Considering what would be involved in causing a change of the composition of the upper atmosphere above 60 or 70 km, the region above the stratosphere, it is necessary to know what the rate of depletion of a given substance is due to mixing and dissociation (by sunlight and chemical reactions), and also what its natural concentration is. These are only known very approximately but it seems that on the order of 10^5 to 10^6 tons per year of water vapor or nitric oxide would have to be injected above 60 km to double the amounts of these gases world-wide, and about the same tonnage would be required to add 10 per cent to the carbon dioxide content. (This corresponds approximately to an annual launching of 10^3 to 10^4 Saturn-type rockets, or of the type of Soviet rocket used to put the second Soviet cosmonaut into orbit.) On the other hand, only 2×10^3 to 10^4 kilograms per year of atomic sodium would have to be injected above 60 km to double this constituent, and only a few tens of kilograms of lithium annually would be expected to double its background concentration. These last figures are within the capability of man now, and may (as mentioned above) have already been achieved temporarily in the case of lithium. The larger figures for nitric oxide, carbon dioxide, and water vapor, the main combustion products of rocket fuels, seem unattainable in the foreseeable future.

The Consultative Group is aware of the various dire consequences of contamination that have been cited in certain public pronouncements, and has

examined them as far as present knowledge would permit. (Examples of these are: the removal of the ozone layer, thereby permitting far ultraviolet sunlight through to the ground; the removal of the free electrons in the ionosphere by introducing an electron "getter" in large quantities; changing the temperature of the atmosphere by changing the water vapor or carbon dioxide content, etc.) We are unable to identify any physical processes which would produce these consequences. Although it is always possible that there might be other undesirable effects which have not been anticipated, this seems unlikely.

6. The present study, which is based on information in the open literature, while providing some comfort as regards climatological changes which may be induced by the rocket gases in the foreseeable future, indicates the need for early experimental and theoretical studies dealing with the following problems:

- (a) the evaluation of exchange times between the various regions of the upper atmosphere, especially between 60 and 100 km, where current estimates of diffusion rates differ by two orders of magnitude in extreme cases and by an order of magnitude generally;
- (b) the short-term local and zonal effects of rocket contamination;
- (c) possible catalytic effects which might trigger chemical and photochemical processes as yet unanticipated;
- (d) radiation balance in the upper atmosphere and the effects on it of changes in composition there.

In view of the importance of developing a sound scientific capability for accurate predictions of the effects of future space operations and experiments which may involve injecting larger amounts of materials with different chemical and physical characteristics, the Consultative Group suggests that COSPAR urges scientists, particularly those of nations which are active in space exploration with large rockets, to undertake serious quantitative studies which could provide answers to some of these questions in the near future.

7. The present study does not include three contingencies of possible significance to the pollution of the upper atmosphere and which may be realized in the next few years. These are:

- (a) the use of nuclear powered rockets and nuclear reactors in satellites;
- (b) the extensive use of high-flying supersonic transport aircraft;
- (c) the extensive use of completely disintegrating meteorological rockets.

It is intended that the Consultative Group will examine these contingencies in a preliminary way during the next year, and will arrange for more detailed studies if warranted.

Appendix 2

Statement on Belts of Orbiting Dipoles

by

The COSPAR Consultative Group on Potentially Harmful Effects of Space Experiments

(16 May 1964)

Belts of orbiting dipoles (needles) have been proposed for the use of a telecommunication system between stations at the earth's surface. Two experiments to create a test belt of this nature have come to our knowledge. The first launched October 1961, did not dispense separate needles; the second, launched 12 May 1963, went as planned. The first announcement of this plan, about August 1960, created grave concern about the possible interference to be expected in optical astronomy by scattered sunlight and in radio astronomy by scattered signals from radio stations on the earth. The calculation of this interference by a specified belt contains no major uncertain factors. It was soon ascertained that the effects of the specified belt would be hardly measurable and would not cause harmful interference. This has been confirmed by the observations of the actual test belt.

In view of initial uncertainties about the life time and in view of the expressed fear that frequent launchings or far denser belts might be proposed, the problem was held under review by several committees of experts. The most important ones, the "West Ford Committee" of the International Astronomical Union and the "Ad hoc West Ford Committee" of the Space Science Board of the National Academy of Sciences of the USA, have now produced their reports with identical conclusions.

The COSPAR Consultative Group on Potentially Harmful Effects of Space Experiments has frequently consulted with members of both committees and is in concurrence with their conclusions. It feels no need, therefore, to repeat these conclusions in detail. The observations and calculations have been published in scientific journals.

As an illustration of the optical effects, we may mention that the scattered sunlight received from the test belt a week after launch was a factor 10 below the brightness of faintest measured parts of galaxies, the study of which forms one of the basic means by which present-day astronomy penetrates the problems of the universe. This margin gets wider as the belt spreads in time.

The possible interference to radio astronomy has been newly evaluated by FINDLAY and RYLE with a view to the types of radiotelescopes that may come into operation within ten years. Interference equal to 1/10th of the effective limit of detection would be produced with a single 10 kw transmitter illuminating part of a belt with a dipole density 5-10 times that of the 60-day West Ford belt.

Experience has shown that there are reasonably good procedures for calculating in advance the effects of any belts.

The numbers quoted above by way of illustration show that the test belt constituted no interference. However, adding a factor 10 would be significant and a factor 100 might be detrimental to much advanced research in astronomy.

The Consultative Group recommends that any future experiments with this general character be given the benefit of a thorough evaluation by the international scientific community and notably by the International Astronomical Union in order to check in advance their harmlessness to other scientific research.

Appendix 3

Statement by the Consultative Group on Potentially Harmful Effects of Space Experiments

concerning

The Contamination of Planets

(Geneva, 1964)

"The COSPAR Consultative Group on Potentially Harmful Effects of Space Experiments has considered presently available scientific evaluations of the likely consequences of the biological contamination of Mars. There is consensus of opinion among scientific workers of the extreme importance of not

jeopardizing the value of information that can be gained from studies of this planet about many crucial problems of biology and the evolution of life. Realizing that the technology of sterilization has many practical problems, the Group is endeavouring to establish through consultation with competent biologists the limits of permissible contamination of objects that may land on Mars. The Group moreover recommends that early discussions be held between specialists of launching nations to discuss techniques of sterilization and problems of technology involved in launching sterilized payloads. In the meantime, the Group urges these nations who presently have capability of attempting the exploration of Mars, to take steps to organize only fly-by missions for the time being."

Appendix 4

Report of the Panel on

Standards for Space Probe Sterilization

At the Florence meeting of COSPAR, the Panel on Standards for Space Probe Sterilization considered data and expressions of expert opinion from a variety of sources. The following statements represent a synthesis of the views of the members of the Panel; it is suggested that they be made the basis of a position paper by COSPAR.

We reaffirm the conviction that exobiology should be a primary objective of activities in the space sciences. This view is justified for the following reasons:

(1) The detection and subsequent investigation of extra-terrestrial life has profound scientific significance.

(2) Studies in planetary biology must, in large part, be completed before contamination is effected by unsterilized devices used in physical or geophysical investigations. The successful performance of physical experiments is primarily unaffected by previous biological experiments; because of contamination, the converse may be false.

(3) A study of the prebiological chemistry of a planet which proves to be sterile would nevertheless be of major biological significance.

We believe that space probe sterilization and trajectory control of fly-by spacecraft are essential until further information gives strong indication that such standards could be relaxed without jeopardizing planetary studies. This policy is justified for the following reasons:

/...

(1) A search for extra-terrestrial life is essentially a search for materials with the properties of the known organisms on the planet Earth. Therefore all life-detection experiments will be capable of detecting viable terrestrial contaminants. Consequently the introduction of such contaminants (for example, by inadequate spacecraft sterilization) would render it impossible to decide whether positive results of a life-detection experiment are significant or spurious.

(2) Aside from such interference with remote life-detection experiments, biological contamination of a planet may lead to undesirable alterations of the planetary environment from the standpoints of both exobiology and physical studies of planetary surfaces. If the proliferation of terrestrial contaminants - at some time after their introduction - is not excluded, the extensive changes in the planetary environment which are possible as a consequence could inhibit or destroy our opportunity to

- (a) identify and investigate the indigenous biota,
- (b) understand the ecological interactions of the original indigenous biota, and
- (c) investigate the prebiological chemistry of a planet which proves to be sterile.

It is difficult to estimate adequately the period of time which would pass before such undesirable consequences occur. As a simple example of heuristic interest we note that a single viable organism deposited in an environment in which it slowly grows (general time, thirty days) would in the course of eight years produce a population of 10^{27} organisms, a number equal approximately to the bacterial population of the Earth. The calculation assumes zero death rate, and no interaction between indigenous planetary organisms and exogenous terrestrial contaminants.

We believe that the scientific desirability of sterility control is absolute; but the degree of sterilization required must be based on our judgements of the risks acceptable so planetary exploration will not be impossibly difficult. The probability that a single viable organism is aboard any space vehicle intended for planetary impact can then be computed as the solution of a waiting time problem in probability theory. Adopting values for the acceptable risk during approximately a decade of planetary exploration by landing vehicles, and for the biological and spacecraft reliability parameters involved - values which we consider conservative - we conclude that

(1) The probability that a single viable organism be aboard any vehicle intended for planetary landing must be less than 1×10^{-4} and that

(2) the probability of accidental planetary impact by an unsterilized fly-by or orbiter must be less than

$$3 \times 10^{-5}$$

during the interval terminating at the end of the initial period of planetary exploration by landing vehicles (approximately one decade).

We appreciate the considerable technical difficulties involved in realizing these probabilities in practice, but we consider that they are attainable by known means. The probabilities also apply to contamination by spacecraft propulsion and attitude-control systems. The probability of contamination by accidental impact of fly-bys and orbiters can be minimized by

(1) initial trajectory control,

(2) initial spacecraft sterilization, or by

(3) inclusion of programmed or commanded terminal precautionary systems

for assuming non-intercept trajectories or for initiating destruction sterilization.

The probabilities given above are obviously subject to future revision as our knowledge of planetary environments, microbial ecology, and spacecraft design improves.

We feel that while our recommendations apply immediately to fly-by, orbiter and lander missions planned for Mars, the same recommendation should apply to any planet which, on the basis of current information, cannot firmly be excluded as a possible abode of extra-terrestrial life. The standards of space vehicle sterilization are, we believe, unrelated to the probability of indigenous life on the planet in question; except in the limiting case that indigenous life and the proliferation of terrestrial contaminants can both be firmly excluded. While there is a sizeable probability that the surface temperatures of Venus are too high for either indigenous or exogenous organisms, this conclusion is based on indirect lines of argument. Also, we cannot entirely exclude the possibility of biological contamination of the clouds of Venus. Until unambiguous astronomical information is available, we recommend that Martian standards of sterility control should also apply to Venus. In the case of the Moon, the surface conditions are rigorous enough to reliably exclude biological contamination of the surface. We cannot exclude the possibility that conditions several tens of metres below the lunar

surface will permit microbial replication. Such depths, however, are unlikely to be reached unintentionally during lunar landings. Accordingly, we recommend such less rigorous sterilization techniques as biocleanroom assembly and terminal gaseous sterilization of all spacecraft intended for lunar landings; but rigorous sterilization of drills designed for lunar subsurface boring. Our information about the conditions on other planets is insufficient to form a basis for definitive recommendations at this time.

To encourage broader consideration of the diverse means which can be employed to meet these recommended standards of sterility, it is suggested that an international conference be sponsored by COSPAR, possibly in co-operation with one or more other appropriate international scientific groups, to consider the technology of sterilization, and sterilization testing. To implement this suggestion, it will be necessary for COSPAR to endorse the proposed conference and to supply a budget for bringing it about. It is suggested further that the conference be held as soon as feasible, preferably in early 1965.
