Document II-9

Document title: U.S. National Committee for the International Geophysical Year 1957-58. "Summary Minutes of the Eighth Meeting," Washington, D.C., May 18, 1955.

Source: Archives, National Academy of Sciences, Washington, D.C.

The idea for holding an International Geophysical Year (IGY) arose from an informal meeting of scientists at the Maryland home of physicist James Van Allen in 1950. The intention was to coordinate high-altitude research conducted around the world. Supporters took the idea to the International Council of Scientific Unions, where it was supported by sixty-seven nations. In October 1954, Lloyd Berkner, one of the scientists at the original meeting, and ten of his associates discussed the problems and rewards of launching a satellite as part of the IGY and agreed unanimously to recommend it to the Special Committee for the International Geophysical Year (CSAGI). On October 4, the CSAGI issued a statement calling for governments to try to launch Earth satellites. The American Long Playing Rocket Proposal followed from that recommendation. The U.S. National Committee for the International Geophysical Year gave formal approval to the project at its May 18, 1955, meeting. The minutes of that meeting have as attachments background on the U.S. satellite proposal.

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[1] 1. **Attendance.**

1.1 Members: Joseph Kaplan (Chairman), A. H. Shapley (Vice-Chairman), L. H. Adams, Wallace W. Atwood, Jr., Lloyd V. Berkner, Earl G. Droessler, J. Wallace Joyce, John P. Marble, E. B. Roberts, Walter M. Rudolph, Paul A. Siple, H. K. Stephenson, Merle A. Tuve, E. H. Vestine (alternate).

1.2 USNC-IGY Secretariat: Hugh Odishaw, Executive Secretary, R. C. Peavey, Administrative Officer.

2. **General Business.**

2.1 Dr. Kaplan announced that Senate hearings on the IGY principal budget were scheduled for 3:00 P.M., today.

2.2 J. Wallace Joyce was introduced to the Committee as Head of the NSF Office for the IGY. Earl G. Droessler was introduced as representing the Office of the Assistant Secretary of Defense (R&D).

2.3 L. V. Berkner noted that Dr. Briggs was in the hospital with a broken leg. It was agreed that a letter would be sent to Dr. Briggs in the name of the Committee expressing hope for a rapid recovery.

3. **Discussion on LPR Program.**

3.1 Dr. Kaplan opened a discussion on the Long Playing Rocket Project (LPR). He stated that this USNC Meeting had been called to review and consider formal approval of the LPR policy, program, and budget, which had been outlined by the USNC Executive Committee. He emphasized that the discussion on LPR must be considered private and confidential within the Committee until high policy decisions had been reached and a public announcement had been made by the Executive Branch of the Government.

3.2 Mr. Odishaw reviewed the history of events leading to the formulation of an LPR Program and Budget as an extension of the conventional Rocket Program proposed for the International Geophysical Year. He read the resolutions passed by the International Union of Geodesy and Geophysics (IUGG) [2] on September 20, 1954; the International Scientific Radio Union (URSI), on September 24, 1954; and the International Council of Scientific Unions Special Committee for the International Geophysical Year (CSAGI) on October 4, 1954 (Appendix I to these Minutes).

Mr. Odishaw then discussed the formation of a special LPR Committee consisting of members of the USNC Technical Panel on Rocketry and the USNC Executive Committee, to consider the technical feasibility of the CSAGI proposal and to suggest experiments which should be performed (Appendix II to these Minutes.) He noted that results of this study (Appendix III to these Minutes) and the proposed program and policy position had been approved unanimously by the USNC Executive Committee at its Meeting March 8-10, 1955, which authorized the Chairman to transmit on March 14, 1955, a policy statement on the LPR Project to the President of the National Academy of Sciences and the Director of the National Science Foundation (Appendix IV to these Minutes).

3.3 Detailed discussion ensued on the technical and scientific objectives as well as financial and political aspects of the LPR Project. It was noted that the vehicle, fuel, and launching system would probably involve unavoidable security problems, but it was explicitly understood that the USNC intended for the bird to be freely available for inspection by other nations participating in the LPR and to be tracked in flight by other nations.

3.4 Following this discussion, the USNC gave formal approval to the resolution adopted by the USNC Executive Committee and the policy statement on the LPR Project transmitted to the President, NAS-NRC and the Director, NSF on March 14, 1955, with one member dissenting.

4. **LPR Budget**.

4.1 Mr. Odishaw reported that on May 5, 1955, the USNC Executive Committee had given instructions for the preparation and transmission of a program and budget for the LPR Project to the Director, NSF, for consideration by the National Science Board at its forthcoming meeting on May 20, 1955. He then reviewed in detail estimated costs, totaling $9,734,500, which includes the cost of ten rocket vehicle systems for instrumented birds.

4.2 After discussion, the USNC gave formal approval to the LPR PROGRAM AND BUDGET DOCUMENT drawn up as of May 6, 1955, for transmittal to the Director of the National Science Foundation, with one member abstaining from the vote (Appendix V to these Minutes).

5. **Other Business**.

5.1 Mr. Odishaw reported that detailed program and budget estimates for scientific projects had been received from the USNC Technical Panels and that copies of all project forms would be mailed to the USNC for review and approval as to acceptance in the U. S. Program for the IGY. The USNC was advised that the Supplemental Budget would be presented to the National Science Board for its consideration on May 20, 1955.

5.2 After approval of these procedures discussed under item 5.1 above, the meeting adjourned.

[3]

Appendix I

International Scientific Resolutions On The Earth Circling Satellite Vehicles

1. **International Union of Geodesy & Geophysics (IUGC)**, September 20, 1954:

"In view of the great importance of observations over extended periods of time of extraterrestrial radiations and geophysical phenomena in the upper atmosphere and the advanced state of present rocket techniques, it is recommended that consideration be given to the launching of small satellite vehicles, their scientific instrumentation and the new problems associated with satellite experiments such as power supply, telemetering, and orientation of the vehicle."

2. **International Scientific Radio Union (URSI)**, September 24, 1954:

"URSI recognizes the extreme importance of continuous observations, from above the E-region of extraterrestrial radiations, especially during the forthcoming AGI.

"URSI therefore draws attention to the fact that an extension of present isolated rocket observations by means of instrumented earth satellite vehicles would allow the continuous monitoring of solar ultraviolet and X-radiation intensity and its effects on the ionosphere, particularly during solar flares thereby greatly enhancing our scientific knowledge of the outer atmosphere."

3. **International Council of Scientific Unions Special Committee for the International Geophysical Year (CSAGI)**, October 4, 1954:

"In view of the great importance of observations during extended periods of time of extraterrestrial radiations and geophysical phenomena in the upper atmosphere, and in view of the advanced state of present rocket techniques, CSAGI recommends that thought be given to the launching of small satellite vehicles, to their scientific instrumentation, and to the new problems associated with satellite experiments, such as power supply, telemetering, and orientation of the vehicle."

[4]

Appendix II

Excerpts
MINUTES
of the
First Meeting
Technical Panel on Rocketry
USNC for the IGY
10:00 - 17:00, January 22, 1955, National Science Foundation
Washington, D. C.

2. **Organization of Panel**

2.1 Dr. Van Allen as convener called the meeting to order and Dr. Spilhaus of the Executive Committee of the U. S. National Committee for the IGY introduced as first order of business a resolution passed by the Executive Committee to be taken up by this panel. A motion was introduced, seconded and carried to the effect that the following part of the meeting on LPR be a closed session, be private, though unclassified, and its record be available to the participants of this closed session only. A record of the Closed Session will be found as Attachment A to these minutes.

[5]

January 22, 1955
Attachment A
REPORT
on the
Closed Session
of the
First Meeting
Technical Panel on Rocketry
U.S.N.C. for the I.G.Y.

1. **Resolution**

1.1 Dr. Spilhaus reported on a resolution passed by the Executive Committee of the U.S. National Committee for the IGY requesting this Panel to perform a study and report on the technical feasibility of the construction of an extended rocket, from here on called LPR, to be launched in connection with scientific activities during the International Geophysical Year.

1.2 This report presents the resolved actions taken on account of the ensuing discussion among the participants of the closed session.

1.3 Participants: N.C. Gerson, B. Haurwitz, J. Kaplan, H.E. Newell, Jr., H. Odishaw, G.F. Schilling, S.F. Singer, A.F. Spilhaus, J.A. Van Allen, F.L. Whipple.

1.4 All contents of this report are classified as private, pending further determination of a suitable security classification, and discussions or communications would be limited to members of the Panel and only those others indicated in 2.2. A motion covering this point was proposed by Dr. Kaplan, seconded, and unanimously passed. Copies of this report, Attachment A to the Minutes of the First Meeting of the Technical Panel on Rocketry of the USNC for the IGY, will be available to participants of this closed session only.

2. **Discussion**

2.1 The ensuing discussion included, in addition to technical details, such topics as the expected reaction of public opinion, the liaison with Government agencies, and the availability of funds.

[6] 2.2 It was finally resolved that a study group to be called LPR Committee would be set up under the chairmanship of Dr. Whipple, consisting of the members of this Panel and the following added consultants: W. Pickering, California Institute of Technology; M.W. Rosen, Naval Research Laboratory; J.W. Townsend, Jr., Naval Research Laboratory.

2.3 This LPR Committee will meet at Pasadena, California, on the evening of February 3, 1955, and possibly on subsequent days, the participants to be informed of exact time and locality by Dr. Van Allen.

2.4 It was resolved that the LPR Committee draft a report on the following topics and/or sub-topics concerning LPR: technical feasibility, budget, geophysical possibilities; controls, motor, manpower, timing, cost estimates, desired orbit; and possibly other pertinent subjects.

2.5 It was resolved that the whole report would either be classified and an unclassified abstract be extracted, or the report would be in two parts, one part carrying a security classification.

2.6 It was resolved that the LPR Committee would send the report to Dr. Spilhaus to be presented to the members of the Executive Committee of the USNC for the IGY, or directly to respective Government agencies such as the National Security Council, upon the discretion of the Chairman of the USNC for the IGY.

2.7 Dr. Haurwitz indicated that due to prior commitments he would be unable to attend the planned meeting on February 3, 1955. He offered to write a letter to Dr. Whipple prior to the planned meeting, containing his contribution for inclusion in the report.

[7]

Appendix III

National Academy Of Sciences - National Research Council
United States National Committee
For The International Geophysical Year 1957-58
Unclassified Excerpts

Prepared by: G.F. Schilling, Program Officer, USNC-IGY
Verified by: H.E. Newell, Jr., Exec. Vice Chairman, USNC
Technical Panel on Rocketry
Approved by: Hugh Odishaw, Executive Secretary, USNC - IGY
Date: August 2, 1955

MINUTES
of the Special Meeting
LPR Committee
Technical Panel on Rocketry
USNC for the IGY
09:00 - 13:00, 9 March 1955, IGY Conference Room
Washington, D. C.

1. **Attendance**

1.1 Members Panel on Rocketry: F.L. Whipple (Chairman), W. Berning, W.G. Dow, N.C. Gerson, J. Kaplan, H.E. Newell, Jr., S.F. Singer, W. Stroud, P.H. Wyckoff

Absent: B. Haurwitz, J.A. Van Allen

1.2 IGY Secretariat: H. Odishaw, G.F. Schilling

1.3 LPR Technical Subcommittee: M.W. Rosen, J.W. Townsend

Absent: W.H. Pickering

1.4 Invited Participants: E.L. Eaton, A.F. Spilhaus, T.B. Walker

3. **Business Session**

3.1 Dr. Whipple, Chairman of the Technical Panel on Rocketry of the USNC for the IGY convened the meeting and called upon Mr. Rosen to present a Report of the LPR Technical Subcommittee, prepared by W.H. Pickering, M.W. Rosen, and J.W. Townsend.

[8] 3.2 Mr. Rosen read and submitted a written report (Attachment A to these Minutes), summarizing three conclusions resolved by the Subcommittee.

3.3 The report was accepted by the Chairman of the Panel and Mr. Rosen was called upon to amplify and detail the content of the report.

4. **Detailed Report by M. W. Rosen**

4.1 Mr. Rosen discussed the following three possible approaches to placing a small payload in an orbit around the earth. He emphasized that all three approaches are feasible with present-day knowledge and facilities, and are presented in the order of difficulty and amount of additional development required.

I. Technique Number One:

This technique suggests the use of a one-stage large rocket plus the release of a number of small rockets, launched at or near the top of the flight path of the large rocket. Three existing large rockets are qualified to be used for the first stage. The guidance can be made accurate to one degree of arc.

II. Technique Number Two:

This technique suggests the use of a two-stage rocket plus one or two more stages of small rockets. The guidance problem of the second stage is more difficult here, than with Technique Number One, but it is technically feasible. The technique gives the possibility of greater payload, i.e., instrumented satellite.

III. Technique Number Three:

This technique may represent the most long-term approach, but offers the greatest payload. The basic suggestion is to start out with the biggest power plant presently in development and to build a test vehicle around it. This would involve a development program for the first stage. Before evaluating this program, a preliminary study of two to three months would be necessary.

5. **Discussion on Size Categories**

5.1 Dr. Whipple started a discussion on desirable size categories. It was apparent that an object of the order of magnitude of one pound would not be useful. An object of the order of magnitude of ten pounds would be observable from ground. Into any object of 30 pounds or more some sort of power could be put, thus making it an instrumented satellite. It was agreed that at the present time the use of nuclear or solar power supplies was doubtful and not technically feasible, therefore batteries would be needed.

[9] 5.2 10 pds Observable Object: Dr. Whipple outlined technical and scientific aspects concerning a 10 pd object. He suggested that it should be about 20 inches in diameter, painted white or have a reflecting surface. It could be observed visually from ground at twilight or dawn, representing a star of a 6th magnitude brightness (60% reflection). Dr. Whipple stated firmly that such an object could be found optically with binoculars and telemeter cameras (Askania system), and discussed the technique applicable to find the object once it was in an orbit.

Such an object would permit determination of atmospheric densities and would preferably be placed in an equatorial orbit. An ideal orbit would have a perigee of about 250 miles and an apogee of about 500 miles. If the object were much bigger in diameter than 20 inches, it would spiral back to earth too fast and make determinations of density more difficult and inaccurate. [Paragraph omitted]

Among further scientific results obtainable, the following projects were mentioned: determinations of inter-continental distances to an accuracy of probably 100 feet, if a time accuracy of about 0.01 seconds (equivalent to approximately 200 feet moving path) can be achieved. The mass and density distribution in the earth's crust, e.g., mountain ranges, might be calculated. [Paragraph omitted]

[11] 5.6 Dr. Singer discussed geophysical and astrophysical applications of an instrumented rocket. He went into details concerning the desirability of measuring various geophysical parameters and a general discussion ensued.

5.7 Dr. Newell reported on an engineering study performed at NRL on a 30 to 50 pd object. He presented a theoretical design of an instrumented 15 inch sphere in an equatorial orbit, fitted out with available instruments. He detailed as follows:

Optical tracking:	same as Dr. Whipple.
Solar batteries:	not practical for next 3 years.

Experiments for an active satellite (the following lists the actually designed instrumentation).

(1) Interplanetary Hydrogen Density (Lyman-alpha)–1 pd, 0.2 watts.
(2) Dual Micrometeor Detector–0.5 pds, 4 watts.
(3) Extraterrestrial and Ionospheric Electric Currents–8 pds,
5 watts, 0.1 watthour per measurement.
(4) Magnetic Aspect Indicator (for orientation)
–0.25 pds, 2 watts.
[Sentence omitted]
(6) Telemetering System–3 .8 pds, 71 watts–batteries 20 pds.
(7) Structure–15 pds.

7. Final Discussion

7.1 It was generally agreed upon that instrumentation costs for any type of object would be negligible in comparison with other costs. This means that a number of small objects could be built relatively inexpensively and more types than one would be possible.

7.2 For technical reasons the majority of the Panel members seemed to favor Technique Number Two applied to a 30 pds observable object.

7.3 The Panel designated Dr. Whipple and Dr. Newell to present an unclassified summary of the findings of this meeting to the Executive Committee of the U.S. National Committee for IGY.

[12]
Appendix III

Attachment A
Report on LPR Subcommittee on Vehicle Capabilities

On Friday, February 11, a committee consisting of Dr. W.H. Pickering, Director, Jet Propulsion Laboratory, California Institute of Technology; Mr. M.W. Rosen, Head, Rocket Development Branch, Naval Research Laboratory; and Mr. J.W. Townsend, Assistant Head, Rocket Sonde Branch, Naval Research Laboratory, met in Washington to consider the feasibility of placing a small payload in an orbit around the earth. All three members of the committee were familiar with several proposals for a small satellite, but not necessarily with all such proposals that may exist. In view of the very brief time available for reaching some conclusions, the committee decided that it could not underwrite any specific proposal and that it could not formulate any specific proposal for a satellite.

The Committee reached the following three conclusions:

1. With regard to propulsive power required for reaching satellite velocity, it is feasible to attain the required velocity for payloads up to 10 pounds using combinations of existing rocket vehicles with a moderate amount of additional development work.

2. A more difficult problem is that of the control or guidance necessary to produce an orbit. This problem can be solved using existing control and guidance components. The precision required for producing an orbit is less stringent than that necessary to meet the specifications for at least several existing guided missile projects. An appreciable amount of development work would be required.

3. The creation of a satellite for payloads up to 10 pounds can be realized within two to three years, provided that sufficient funds and manpower are applied....

[13]
Appendix IV

National Academy Of Sciences
National Research Council of the United States Of America

United States National Committee
International Geophysical Year 1957-58
March 14, 1955

Identical Letter was addressed to:
Director, National Science Foundation

Dr. Detlev W. Bronk, President
National Academy of Sciences
2101 Constitution Avenue
Washington 25, D. C.

Dear Dr. Bronk:

A small, approximately fifty-pound, earth-circling satellite which could be freely inspected before launching and tracked in flight by international agencies would be in accord with recommendations of the Comite Special Annee Geophysique Internationale 1957-58 (CSAGI) at its Rome meeting in 1954, and would yield new geophysical data of considerable interest. If such vehicles could be constructed and launched within the spirit of the International Geophysical Year, the Executive Committees of the U.S. National Committee for the International Geophysical Year, on basis of studies and reports by its rocket panel, recommends that the U.S. Government include such vehicles in its rocket program, and provide the U.S. National Committee with opportunity to install the orbiting vehicles for such flights.

A resolution adopted by the Executive Committee of the USNC is presented herewith:

The Executive Committee of the U.S. National Committee for the International Geophysical Year notes that the following resolution was adopted by the CSAGI in Rome, Italy, during 1954: "In view of the great importance of observations over extended periods of time of extraterrestrial radiations and geophysical phenomena in the upper atmosphere, and in view of the advanced state of present rocket techniques, it is recommended that thought be given to the launching of small satellite vehicles, to their scientific instrumentation, and to the new problems associated with satellite experiments, such as power supply, telemetering, and orientation of the vehicle." The Executive Committee of the U.S. National Committee for the International Geophysical [14] Year, basing its opinion on the study of its expert panel on rocketry, feels that a small artificial satellite for geophysical purposes is feasible during the International Geophysical Year if action is initiated promptly and that the realization of such a satellite would give promise of yielding original results of geophysical interest.

I am also submitting the above information and resolution to the Director of the National Science Foundation.

Sincerely yours,
Joseph Kaplan
Chairman

[16]
Appendix V

National Academy Of Sciences
National Research Council of the United States Of America
United States National Committee
International Geophysical Year 1957-58
May 6, 1955

The Honorable
Alan T. Waterman, Director
National Science Foundation
1520 - H Street, N.W.
Washington 25, D. C.

Dear Dr. Waterman:

I am writing to present to you the budget and related recommendations of the USNC Executive Committee on the proposed USNC-IGY Project LPR (Long Play Rocket), constituting also an amplification of my letter of March 14, 1955, to the President of the National Academy of Sciences and you on this subject. While this represents an official action by the Executive Committee, final approval by the full USNC is also necessary: a special meeting, as indicated below, will be called as soon as you have advised me on the existence of a favorable Government policy.

The Executive Committee at its Seventh Meeting, May 5, 1955, acted favorably upon the enclosed budget estimate totalling $9,734,500 (see Attachment A). This estimate includes not only provisions for (i) approximately ten "birds" and five observation stations, including the necessary scientific instrumentation, related equipment, and minimum civilian scientific staff but also provisions for (ii) approximately ten vehicles and their associated flight instrumentation. Cost estimates for (i) are $2,234,500; for (ii) $7,500,000; and the total comes to $9,734,500.

Although in our earlier discussions, with which you are familiar, the Executive Committee had considered that the USNC-IGY program need only include item (i), the Executive Committee now believes that item (ii) ought also to be part of the IGY budget. There are several reasons for this conclusion: first, it would be more fully in the spirit of the IGY for the USNC-IGY to sponsor and provide support for the total equipment and instrument needs (analogous to the present rocket program), clearly establishing the basic civilian character of the endeavor; second and somewhat related to the preceding clause, there appears to be no fundamental classification problem involved in the vehicles: without reference to the history of rocketry (in particular, German V-2 developments), such rockets as the Viking and Aerobee, combinations of which are capable of doing the job, [17] are commercially available and involve no security classification considerations, an important factor in terms not only of the philosophy of the IGY but, we believe, in terms of the international relations of the United States; and, third, the inclusion of (i) and (ii) in the USNC-IGY program provides a simplicity in the demarcation of USNC-IGY and DOD responsibilities, the latter, as in the rocket program, having to do with logistics and operational support.

These and related topics are the subject of the narrative accompanying the enclosed budget (see Attachment A); the views of the Executive Committee on the budget itself can be summarized briefly by quoting the Minutes of the Seventh Meeting: "With the understanding that the totals for vehicles for launching of approximately 10 birds at a cost not to exceed $7.5 million for procurement, construction, and necessary system design and development, and $2,234,500 for procurement, construction, and design relating to birds and observing equipment, the USNC Executive Committee recommends to the National Science Foundation that the entire LPR program be funded from IGY funds, provided that procurement, logistics and launching be coordinated by the appropriate DOD agency."

I should like at this time to dwell briefly on the urgency of this matter: namely, unless funds are available within a very brief interval after July 1, 1955, it will be virtually impossible to be sure that the LPR program can be conducted during the IGY. The critical shortage of time can not be over-emphasized. You will recall that my letter of March 14, 1955, contained the phrase "if action is initiated promptly." The enclosed copy of a newspaper article (see Attachment C) may be of interest to you, showing as it does the interest of other nations in such a program.

The Executive Committee assumes that a favorable Government position, emanating from the highest levels within the Executive Branch, will have been reached in the very near future on this program so that the following steps can be taken: (i) approval by the full U.S. National Committee, (ii) submission to the National Science Board at its May meeting, and (iii) submission to the Bureau of the Budget and the Congress during the present session in the hope that funds can be granted by July 1, 1955, or earlier if possible. Aspects of the critical timetable confronting us are described in Attachment B.

I know that you have been pursuing this matter diligently, and the Executive Committee is appreciative of your interest and assistance. I hope to hear from you soon in order to call a special meeting of the USNC, and I and my colleagues shall be pleased to appear before the National Science Board, the Bureau of the Budget, and the Congress on this subject as we have in the past in connection with other aspects of the IGY program.

Sincerely yours,
Joseph Kaplan
Chairman

Attachments

[18]
Appendix V

Attachment A

USNC-IGY LPR (Long Play Rocket) Program
Program and Estimated Budget

1. **International Background**

The desirability of launching small instrumented vehicles for geophysical research during the International Geophysical Year (1957–58) was the subject of discussion at three international meetings last year:

(i) In August and September, 1954, the International Scientific Radio Union (URSI) considered this matter and endorsed the following resolution:

"Study of Solar Radiation in the Upper Atmosphere.

URSI recognizes the extreme importance of continuous observations, from above the E region of extraterrestrial radiations, especially during the forthcoming AGI.

URSI therefore draws attention to the fact that an extension of present isolated rocket observations by means of instrumented earth satellite vehicles would allow the continuous monitoring of solar ultraviolet and X radiation intensity and its effects on the ionosphere, particularly during solar flares thereby greatly enhancing our scientific knowledge of the outer atmosphere."

(ii) The International Union of Geodesy and Geophysics submitted to the Special Committee for the International Geophysical Year (CSAGI) the following recommendation of its International Association of Terrestrial Magnetism and Electricity (September 20, 1954):

"In view of the great importance of observations over extended periods of time of extraterrestrial radiations and geophysical phenomena in the upper atmosphere and the advanced state of present rocket techniques, it is recommended that consideration be given to the launching of small satellite vehicles, their scientific instrumentation and the new problem associated with satellite experiments such as power supply, telemetering, and orientation of the vehicle."

(iii) The CSAGI at its final plenary session on October 4, 1954, adopted the following resolution:

"In view of the great importance of observations during the extended periods of time of extraterrestrial radiations and geophysical phenomena in the upper atmosphere, and in view of the advanced state of present [20] rocket techniques, CSAGI recommends that thought be given to the launching of small satellite vehicles, to their scientific instrumentation, and to the new problems associated with satellite experiments, such as power supply, telemetering, and orientation of the vehicle."

An indication of international interest is apparent in the news article enclosed herewith as Attachment C.

2. **National Background**

In view of the above International recommendations and in view of the advanced state of U.S. rocketry developments, the Executive Committee of the U.S. National Committee for the IGY considered the possibility of constructing, launching, and observing an instrumented satellite. A special group for this purpose was established within the USNC Technical Panel on Rocketry.

On the basis of studies made by the above group, the Executive Committee decided that an instrumented satellite program was of scientific importance and was feasible. The Executive Committee summarized its findings as follows (March 8 and 10, 1955):

"A small, approximately fifty-pound, earth-circling satellite which could be freely inspected before launching and tracked in flight by international agencies would be in accord with recommendations of the Comite Special Annee Geophysique Internationale 1957-58 (CSAGI) at its Rome meeting 1954, and would yield new geophysical data of considerable interest. If such vehicles could be constructed and launched within the spirit of the International Geophysical Year, the Executive Committee of the U.S. National Committee for the International Geophysical Year, on basis of studies and reports by its rocket panel, recommends that the U.S. Government include such vehicles in its rocket program, and provide the U.S. National Committee with opportunity to install the orbiting vehicles for such flights."

The Executive Committee adopted the following resolution, March 8 and 10, 1955:

"The Executive Committee of the U.S. National Committee for the International Geophysical Year notes that the following resolution was adopted by the CSAGI in Rome, Italy during 1954: 'In view of the great importance of observations over extended periods of time of extraterrestrial radiations and [21] geophysical phenomena in the upper atmosphere, and in view of the advanced state of present rocket techniques, it is recommended that thought be given to the launching of small satellite vehicles, to their scientific instrumentation, and to the new problems associated with satellite experiments, such as power supply, telemetering, and orientation of the vehicle.' The Executive Committee of the U. S. National Committee for the International Geophysical Year, basing its opinion on the study of its expert panel on rocketry, feels that a small artificial satellite for geophysical purposes is feasible during the International Geophysical Year *if action is initiated promptly* [emphasis added] and that the realization of such a satellite would give promise of yielding original results of geophysical interest."

The Executive Committee authorized the Chairman of the U.S. National Committee to transmit the above findings and resolution to the President of the National Academy of Sciences and the Director of the National Science Foundation. This was done on March 14, 1955.

3. **USNC-IGY LPR Program**

The Executive Committee of the USNC-IGY proposes a minimum satellite program during the IGY consisting of approximately ten instrumented birds, with the expectation that at least five of the birds will be successfully launched into their orbits, circulating about the earth for a period of approximately two weeks, at a height of about 250 miles, traveling about the equator. Five ground stations will be established for observations and measurement purposes, one each in the Equatorial Pacific, South America, the Atlantic Ocean, Africa, and the Philippines.

The instrumented satellites will permit the performance of a number of important experiments. The simplest and most direct will be the use of the satellite for precise geodetic measurements and the determination of upper air densities. Instrumentation now planned will permit the following investigations: Measurement of solar radiation, measurement of particle radiation such as micrometeorites and those responsible for the aurora, and determination of current flows in the ionosphere associated with magnet storms and radio black-outs. Such a vehicle would also permit the determination of hydrogen in inter-planetary space.

To achieve the objectives of the program, the USNC Executive Committee recommends the following definitions of responsibility:

(i) That the program be an integral part of the USNC-IGY program for both scientific and international reasons and that the execution of the program be under the direction of the USNC and its appropriate Committees and Panels.

[22] (ii) That the USNC-IGY budget include the (a) procurement of instrumented

birds, (b) the procurement of the rocket vehicle systems, (c) ground stations, their scientific instrumentation, and immediately associated supplies, and (d) provisions for the employment (and travel) of 25 scientists; and that the USNC-IGY LPR budget be presented to the Government and Congress under the auspices of the National Science Foundation.

(iii) That the U.S. Government, through the Department of Defense and under the scientific direction of the USNC, assume overall responsibility for the task, establish responsibility within the Department for the task, set up the appropriate working groups and task forces, and provide (a) scientific and technical personnel for vehicles, launching, and instrumentation of vehicles and birds, (b) all technical and field facilities, including laboratories (domestic and field), related structures, and quarters for personnel (including maintenance and subsistence equipment, supplies and services), (c) logistics support, (d) operational support, including transportation and vehicles, domestic and field, and (e) all other types of support, equipment and services essential for the success of the program but not noted in items (a) through (d) and not included in the USNC-IGY LPR budget.

(iv) That cooperation of scientists from other nations be invited with respect to (a) the instrumented bird and (b) the observation program, including provisions for participation in observations at our field stations as well as issuance of data permitting ease of observation from other than our field stations.

4. **Budget Estimate and Time Schedule**

The attached budget estimate sheet presents current estimates of that portion of the proposed program that appropriately belongs in the IGY budget. If the program is to be effected during the IGY, funds must be available early in Fiscal Year 1956; Attachment B describes aspects of the timetable.

May 6, 1955

[24]
USNC-IGY LPR (Long Play Rocket) Program
Budget Estimates
(May 6, 1955)

Salaries .... $ 215,000
Two professionals at each of 5 stations for one year at an average salary of $9,500, ten man-years: $95,000; three professionals at each of 5 stations for one year at an average salary of $8,000, fifteen man-years: $120,000.

Travel 217,500
Round-trip travel for each of 5 men at each of 5 stations for an average of five shoots, 125 round trips at an average cost of $1,400: $175,000. Per diem for a period of 20 days for each of the 125 trips at an average daily cost of $12: $30,000. Domestic travel, including per diem, $12,500.

Transportation of things 222,000
Transportation of supplies and materials, $21,000; transportation of equipment and facilities, $201,000.

Supplies and materials 140,000
Photographic supplies at $2,000 per station: $10,000; electronic parts and components at $20,000 per station: $100,000; electrical supplies at $2,000 per station: $10,000; laboratory, office, and miscellaneous supplies at $4,000 per station: $20,000.

Equipment and facilities 8,940,000
Design of instrumented bird, $100,000; construction of approximately ten instrumented birds, at approximately $25,000 each: $250,000; five telemetering stations at $50,000 each: $250,000; three C-W triplet-antenna Tracking Stations for each of three stations at $200,000 each: $600,000; two theodolite optical tracking stations for each of two stations at $100,000 each: $200,000; five sets of manual optical tracking gear for the five stations at $8,000 per station: $40,000; approximately 10 rocket vehicle systems, including procurement of rockets and associated control equipment and related devices and the necessary design and development to synthesize the vehicle system, at approximately $750,000 each: $7,500,000.

Total 9,734,500

[25]
Attachment B

Factors Affecting USNC-IGY LPR Schedule

The resolution of the USNC Executive Committee, March 8-10, 1955 (see Section 2 of Attachment A) pointed out that the LPR program is feasible during the IGY "*if action is initiated promptly*" [emphasis added]. Funds must be available promptly—no later than early in Fiscal Year 1957; *preferably sooner*—if the objectives of the program are to be achieved during the IGY. There are important reasons for stressing time: the data provided by the LPR program would have considerable added value primarily because this data could be usefully correlated with large bodies of indirect data gathered during the IGY from all parts of the world. It is of interest also to note that at least one other nation has announced plans for a similar program (see Attachment C) under the direction of an extremely able physicist.

It appears that at least the following steps are involved in the carrying of this proposal to the funding stage:

1. Government Policy
    - 1.1 Departments and Independent Agencies
    - 1.2 National Security Council
2. U.S. National Committee Approval
3. National Science Board Approval
4. Bureau of the Budget Approval
5. Presentation to the Congress

In view of the limited time between now and the end of the current session of Congress, it is evident that prompt action must characterize Governmental considerations. It is understood that vigorous action with respect to step (1) has been undertaken by the National Science Foundation, following the March 14, 1955, letter from the USNC Chairman: as of May 6, 1955, however a Government position had not been defined. Once this position has been defined, involving basically three considerations [(i) general favorable positions of such agencies as the Department of State, (ii) assumption of responsibility by DOD as outlined in item (iii) of Section (3) of Attachment A but without requiring, at this time, a decision as to how DOD will establish its task group, and (iii) approval by the NSC], a special meeting of the USNC will be called for approval of the Executive Committee recommendations. The next step will require prompt consideration by the National Science Board in order to permit submission of the budget to the Bureau of the Budget and Congress.

May 6, 1955

[25]

Attachment C

Interplanetary Commission Created
Russians Planning Space Laboratory for Research Beyond Earth's Gravity

LONDON, April 16 (AP). —Russia announced tonight her top scientists are working on a space laboratory which would revolve around the earth as a satellite.

"A permanent Interdepartmental Commission for Interplanetary Communications has been created in the Astronomic Council of the USSR Academy of Sciences," said Moscow Radio.

"This Commission is coordinating work on problems of mastering cosmic space."

Peter Kapitsa, 61, one of Russia's best known atomic scientists, was among those appointed to the Commission.

Anatoly Karpenko, secretary of the Commission, was quoted as saying:

"One of the first tasks of the Commission lies in organizing work for the creation of an automatic laboratory of scientific research in cosmic space.

"With the ship of such a laboratory—which could, over a long period, revolve around the earth as a satellite, beyond the limit of the atmosphere—it will be possible to carry out observations of phenomena inaccessible under ordinary terrestrial conditions."

With this automatic equipment, Karpenko said, Soviet biologists will be able to obtain information about conditions of life in the absence of gravity.

"Astro-physicists will be able to observe the ultraviolet and roentgen spectra of the radiation of the sun and the stars and, with the help of these observations, to obtain additional data concerning the processes taking place on these bodies.

"Radio physicists will study more completely processes in the ionosphere and will determine the most advantageous conditions for the establishment of radio communications with future space ships."

He said Russia's cosmic laboratory will enable her scientists to penetrate deeper into the secrets of the universe and "will represent the first stage in the solution of the problem of interplanetary communication."

—Washington Post
April 17, 1955

Document II-10

Document title: National Security Council, NSC 5520, "Draft Statement of Policy on U.S. Scientific Satellite Program," May 20, 1955.

Source: Presidential Papers, Dwight D. Eisenhower Library, Abilene, Kansas.

This is the first statement of national policy for outer space. There were three satellite programs under consideration in early 1955. Two—Project Orbiter and WS 117L—were aimed at military and intelligence goals. The other was the IGY satellite being advocated by the National Academy of Sciences and the National Science Foundation. This policy statement emphasizes the political benefits of having the first U.S. satellite launched under international scientific auspices.

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[1] 1. The U. S. is believed to have the technical capability to establish successfully a small scientific satellite of the earth in the fairly near future. Recent studies by the Department of Defense have indicated that a small scientific satellite weighing 5 to 10 pounds can

be launched into an orbit about the earth using adaptations of existing rocket components. If a decision to embark on such a program is made promptly, the U. S. will probably be able to establish and track such a satellite within the period 1957-58.

2. The report of the Technological Capabilities Panel of the President's Science Advisory Committee recommended [phrase excised during declassification review] an immediate program leading to a very small satellite in orbit around the earth, and that re-examination should be made of the principles or practices of international law with regard to "Freedom of Space" from the standpoint of recent advances in weapon technology.

3. On April 16, 1955, the Soviet Government announced that a permanent high-level, interdepartmental commission for interplanetary communications has been created in the [2] Astronomic Council of the USSR Academy of Sciences. A group of Russia's top scientists is now believed to be working on a satellite program. In September 1954 the Soviet Academy of Sciences announced the establishment of the Tsiolkovsky Gold Medal which would be awarded every three years for outstanding work in the field of interplanetary communications.

4. Some substantial benefits may be derived from establishing small scientific satellites. By careful observation and the analysis of actual orbital decay patterns, much information will be gained about air drag at extreme altitudes and about the fine details of the shape of and the gravitational field of the earth. Such satellites promise to provide direct and continuous determination of the total ion content of the ionosphere. These significant findings will find ready application in defense communication and missile research. When large instrumented satellites are established, a number of other kinds of scientific data may be acquired. The attached Technical Annex (Annex A) contains a further enumeration of scientific benefits.

5. [Paragraph excised during declassification review]

[3] 6. Considerable prestige and psychological benefits will accrue to the nation which first is successful in launching a satellite. The inference of such a demonstration of advanced technology and its unmistakable relationship to inter-continental ballistic missile technology might have important repercussions on the political determination of free world countries to resist Communist threats, especially if the USSR were to be the first to establish a satellite. Furthermore, a small scientific satellite will provide a test of the principle of "Freedom of Space." The implications of this principle are being studied within the Executive Branch. However, preliminary studies indicate that there is no obstacle under international law to the launching of such a satellite.

7. It should be emphasized that a satellite would constitute no active military offensive threat to any country over which it might pass. Although a large satellite might conceivably serve to launch a guided missile at a ground target, it will always be a poor choice for the purpose. A bomb could not be dropped from a satellite on a target below, because anything dropped from a satellite would simply continue alongside in the orbit.

[4] 8. The U. S. is actively collaborating in many scientific programs for the International Geophysical Year (IGY), July 1957 through December 1958. The U. S. National Committee of the IGY has requested U. S. Government support for the establishment of a scientific satellite during the Geophysical Year. The IGY affords an excellent opportunity to mesh a scientific satellite program with the cooperative world-wide geophysical observational program. The U. S. can simultaneously exploit its probable technological capability for launching a small scientific satellite to multiply and enhance the over-all benefits of the International Geophysical Year, to gain scientific prestige, [phrase excised during declassification review] The U. S. should emphasize the peaceful purposes of the launching of such a satellite, although care must be taken as the project advances not to prejudice U. S. freedom of action (1) to proceed outside the IGY should difficulties arise in the IGY procedure, [sentence excised during declassification review]

9. The Department of Defense believes that, if preliminary design studies and initial critical component development are initiated promptly, sufficient assurance of success in

establishing a small scientific satellite during [5] the IGY will be obtained before the end of this calendar year to warrant a response, perhaps qualified, to an IGY request. The satellite itself and much information as to its orbit would be public information. The means of launching would be classified.

10. A program for a small scientific satellite could be developed from existing missile programs already underway within the Department of Defense. Funds of the order of $20 million are estimated to be required to give reasonable assurance that a small scientific satellite can be established during 1957-58 (See Financial Appendix).

[6] **Courses of Action**

11. Initiate a program in the Department of Defense to develop the capability of launching a small scientific satellite by 1958, with the understanding that this program will not prejudice continued research [phrase excised during declassification review] or materially delay other major Defense programs.

12. Endeavor to launch a small scientific satellite under international auspices, such as the International Geophysical Year, in order to emphasize its peaceful purposes, provided such international auspices are arranged in a manner which:

a. Preserves U.S. freedom of action in the field of satellites and related programs.

b. Does not delay or otherwise impede the U.S. satellite program and related research and development programs.

c. Protects the security of U.S. classified information regarding such matters as the means of launching a scientific satellite.

d. Does not involve actions which imply a requirement for prior consent by any nation over which the satellite might pass in its orbit, and thereby does not jeopardize the concept of "Freedom of Space."

[7] **Financial Appendix**

1. Funds of the order of $20 million are estimated to be required to assure a small scientific satellite during the period of the IGY. This figure allows for design and production of adequate vehicles and for scientific instrumentation and observation costs. It also includes preliminary back-up studies of an alternate system without vehicle procurement. The ultimate cost of a scientific satellite program will be conditioned by (1) size and complexity of the satellite, (2) longevity of each satellite, and (3) duration of the scientific observation program. Experience has shown that preliminary budget estimates on new major experimental and design programs may not anticipate many important developmental difficulties, and may therefore be considerably less than final costs.

2. The estimate of funds required is based on:

satellite vehicle	$10-$15 million
instrumentation for tracking	$2.5 million
logistics for launching and tracking	$2.5 million
TOTAL	$15-$20 million

3. These estimates do not include funding for military research and development already part of other missile programs. They include costs for observations that might properly be undertaken by Department of Defense agencies as part of the Department of Defense mission. They do not include costs of other observations that may be proposed by other agencies. They will provide a minimum satellite for which two vehicle systems now under study offer good promise, "Orbiter" and "Viking." They also include exploratory studies for a back-up program based upon the "Atlas" missile and "Aerobee" research rocket development.

[8]
Annex A
Technical Annex

Scientific Values

1. The scientific information that may be expected from a satellite is dependent upon the size of the vehicle and whether it can be instrumented.

2. From a small, inert, trackable satellite, it is reasonable to expect that the following scientific values may be derived:

a. Analysis of currently available information on the upper atmosphere shows a need for additional basic information to support the development of manned craft and missiles for use at high altitudes. More accurate data on air density, pressure and temperature are required. From the analysis of actual orbital "decay" patterns, the air drag at high altitudes can be determined to a greater accuracy than by techniques now available.

b. Electronic tracking would probably permit direct and continuous determination of the total ion content of the ionosphere by comparison of simultaneous electronic and visual observations.

c. Anti-missile missile research will be aided by the experience gained in finding and tracking artificial satellites. It is expected that the satellite will approximate the speed and altitude of an intercontinental ballistic missile.

d. It is probable that a small scientific satellite would yield measurements of high geodetic value. More precise determinations of relative position between continents, the value of the gravitational constant averaged over long distances and the earth's semimajor axis can probably be made by observations of a small scientific satellite.

e. The observation of an uninstrumented satellite in an orbital plane inclined to the equator can permit the determination of the rotation of the orbital plane in space about the earth's polar axis, commonly called the "regression of the nodes." This perturbation is caused by the oblateness of the earth. Its evaluation will have considerable significance in precisely forecasting satellite orbits.

[9] **Military Values**

3. In addition to the scientific values listed above, some of which are clearly relevant to missile and anti-missile research and development programs of the Department of Defense, it may be noted that military communications programs will be enhanced by improvements in knowledge of the ionosphere and by improved knowledge of the rate of earth rotation. To this list must also be added the direct values of experience in organization, operation and logistics accruing to military missile forces detailed to execute a scientific satellite firing program. It is expected that the satellite will approximate the speed and altitude of an intercontinental ballistic missile.

Orbit and Tracking Considerations

4. If a perigee approximating 200 miles and an apogee approximately 1,000 miles are used to fix the desired orbit, the satellite will pass completely around the earth in approximately 90 minutes. If an orbit over the earth's poles or an orbit inclined to the equator is selected, the satellite will pass successively farther west of the launching point on each revolution around the earth. This means that an individual tracking station set up for inclined orbits will not be in an observing position for every revolution. The optimum location for tracking polar orbits is at or near the poles. On the other hand, an equatorial orbit will place each observing station in position to observe every circuit of the satellite. Artificial satellites in a low roughly circular orbit will appear optically similar to a 5.6 magnitude star moving at a high angular rate. Optical observations in broad daylight will be impracticable and observations when the satellite is in the earth's shadow will also be impracticable unless the satellite is illuminated. This means that experiments depending on passive optical tracking of a satellite cannot be conducted except during 50 minutes at

dawn and 50 minutes at dusk. An inclined orbit would thus materially reduce the usable data per station for experiments based on passive optical observations. The usefulness of the satellite and the selection of the desirable orbit is, therefore, closely related to the degree to which the satellite can be acquired and tracked by electronic techniques as well as optical.

5. An inclined orbit utilizing Patrick Air Force Base at Cocoa, Florida, as a launching point has the following advantages over an equatorial orbit:

a. Eliminated necessity to mount tropical expedition to establish launching and tracking sites.

[10] b. Permits observation from Navy Air Missile Test Center, Point Mugu, California; Naval Ordnance Test Station, Inyokern, California; White Sands Proving Ground, New Mexico; British-Australian Guided Missile Range, Woomera, Australia; and a large number of the free world's astronomical observatories.

c. Utilizes the full length (5000 miles) of Long Range Proving Ground for observations of the critical first part of the first orbit.

d. Permits an accumulation of geophysical data over a larger area of the earth's surface.

6. Disadvantages of an inclined orbit when compared to an equatorial orbit are:

a. Inclined orbit provides fewer opportunities to observe from a single base. This is especially critical for small uninstrumented satellites not observable by ordinary radar.

b. Inclined orbit from Patrick Air Force Base reaching a maximum latitude of 35° would result in the satellite passing on different circuits over virtually all of the world between 35°N latitude and 35°S latitude. This might increase substantially the amount of diplomatic negotiations necessary to implement the program.

Hazards to Human Life

7. The launching of a scientific satellite does not appear to threaten in any serious way the safety of air transportation at normal altitudes, nor the safety of personnel and property on the ground. All of the scientific satellites discussed above would be launched from locations where the initial flight of the booster system would be over water. At the end of this stage the booster rocket, which is the largest and potentially most lethal part of the satellite, would separate and fall into the water. Normal precautions taken in launching ordinary guided missiles would suffice to assure adequate safety of the launch and booster phases. The orbiting vehicle in all cases of both instrumented and uninstrumented satellites would be designed with the objective in mind that the entire device would disintegrate and to a large extent vaporize under the heat of re-entry into the earth's atmosphere. This vehicle would, therefore, create negligible hazards after re-entering the atmosphere.

[11]

Annex B

The White House

Washington

Copy May 17, 1955

Memorandum For Mr. James S. Lay, Jr.

Executive Secretary

National Security Council

Subject: U. S. Scientific Satellite Program

1. I should like to register my enthusiastic support of the proposal of the Department of Defense (RD-CGS 202/4) which you sent to me under cover of your memorandum of May 13, 1955.

2. I am impressed by the psychological as well as by the [phrase excised during declassification review] advantages of having the first successful endeavor in this field re-

sult from the initiative of the United States, and by the costly consequences of allowing the Russian initiative to outrun ours through an achievement that will symbolize scientific and technological advancement to peoples everywhere. The stake of prestige that is involved makes this a race that we cannot afford to lose.

3. Because of the basically new questions of ionosphere jurisdiction that are involved, and because the announced Soviet program in interplanetary communications makes it certain that a vigorous propaganda will be employed to exploit all possible derogatory implications of any American success that may be achieved, it is highly important that the U. S. effort be initiated under auspices that are least vulnerable to effective criticism. The extraordinary opportunities for exploitation of superstitions on the one hand and of imputed military hazards on the other that are inherent in a scientific "breakthrough" of such novelty make it imperative to enlist many voices speaking for numbers of nations to allay the potentially boundless fears that may be stirred up, even though they are quite unwarranted.

[12] I agree, therefore, with the suggested procedure of having our Government announce that it is ready to support the project through the U.S. National Committee of the International Geophysical Year. It is important for the following reasons that the U.S. proposal be made public at the time when it is submitted to the IGY:

A. The International Geophysical Year was established by the International Union of Scientific Societies which in turn is affiliated with UNESCO—part of the United Nations structure.

B. I am informed that the IGY in its Rome meeting last year endorsed the launching of a satellite as a desirable scientific step.

C. Since Russia is represented in this organization it would be in a position to know immediately of any U.S. offer made by the Government through the U.S. National Committee to launch a satellite.

D. If the U.S. offer was not made public the Soviets might take immediate action and do one of two things:

1) Announce it has already launched a satellite.
2) Make an offer to launch one themselves.

thus reducing the psychological significance and prestige values of the U.S. proposal.

4. The announcement of the U.S. offer might be made by Ambassador Lodge to the United Nations. Although the IGY is affiliated with the United Nations, for public reassurance the Ambassador might state that the United States would welcome some form of direct U.N. sponsorship for the project since its intent was to contribute to the world body of scientific knowledge through study of the satellite in flight. Needless to say, the offer of sharing knowledge would not be extended to the method of launching.

5. The fact that Russia was represented upon the International Geophysical Year which endorsed a satellite launching project can be used to good effect by us in the event that there should be a concerted Communist effort to brand the project as evil or threatening. We should, alternatively, be ready to meet a Soviet statement that it, too, is preparing to launch a satellite upon a shorter time-table or even, at some date, an announcement, true or false, that it has launched one.

[13] 6. Since a U.S. success in being the first to launch a small uninstrumented satellite could be quickly discounted if the Soviets were to follow it with an initial success in the launching of a satellite of more sophisticated type, I believe that the exploratory work on the latter type recommended in paragraph 11 C of the Department of Defense memorandum should be pursued vigorously in the United States concurrently with the program recommended for immediate implementation.

Nelson A. Rockefeller
Special Assistant

Document II-11

Document title: S.F. Singer, "Studies of a Minimum Orbital Unmanned Satellite of the Earth (MOUSE)," *Astronautica Acta*, 1 (1955): 171-84.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

S. Fred Singer, a physicist at the University of Maryland, proposed a Minimum Orbital Unmanned Satellite of the Earth (MOUSE) at the fourth Congress of the International Astronautics Federation in Zurich, Switzerland, in the summer of 1953. Singer's paper was based on a study prepared two years earlier by members of the British Interplanetary Society who had based their proposal on the use of a V-2 rocket. The Upper Atmosphere Rocket Research Panel at White Sands discussed Singer's plan in April 1954. In May, Singer presented his MOUSE proposal at the Hayden Planetarium's fourth Space Travel Symposium.

Singer had been present at the spring 1950 meeting at James Van Allen's home where the prospect of an International Geophysical Year was discussed, and he became a vocal proponent of building a satellite for the IGY. MOUSE was the first satellite proposal widely discussed in non-governmental engineering and scientific circles.

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[171]

Studies of a Minimum Orbital Unmanned Satellite of the Earth (MOUSE)[1]

Part I. Geophysical and Astrophysical Applications[2]

by S.F. Singer, College Park/Md.[3], ARS

(Received August 29, 1955)

Editor's Note. The announcement by President Eisenhower on July 29, 1955 about the launching of minimum satellites by the United States during the International Geophysical Year 1957-58 has made the present article quite topical.

While it is too early to speculate about the details of the U.S. satellite program, the announced dimensions, payloads and applications resemble very much those of a MOUSE satellite. It will be remembered that in 1954 the International Scientific Radio Union (URSI) in the Hague and the International Union of Geodesy and Geophysics (UGGI) in Rome both endorsed resolutions proposed by Professor Singer to apply artificial satellites to geophysical and astrophysical research.

Abstract. A MOUSE would provide a far-reaching extension of present high altitude rockets in the study of the upper atmosphere and extraterrestrial radiations. Lifetimes of even a few days and payloads as low as 50 pounds would be adequate to allow continuous observations of the *solar ultraviolet* and *X-radiations* which have a profound influence on the ionosphere and therefore on radio communications. The cause of *magnetic storms* and

1. Presented in this form at the 25th Anniversary Spring Meeting of the American Rocket Society, Baltimore, Maryland, April 20, 1955. The substance of this paper was first presented at the Fourth Congress of the I.A.F., Zurich, 1953.
2. Part II "Orbits and Lifetimes of Minimum Satellites" was presented as a paper at the New York meeting of the American Rocket Society, Dec. 1954.
3. Associate Professor, Department of Physics, College Park, Maryland, U.S.A.

aurorae could be established with more certainty. Observations of *cosmic rays* would help clear up the question of their origin. Various other astrophysical phenomena, such as *micrometeorites*, could be brought under direct observation. Measurement of the *earth's albedo* (reflected sunlight) would give a measure of total world cloud coverage which could be used to predict long term climatic changes. Radio transmissions from MOUSE would send back all data and allow at the same time a study of the *ionosphere.* The change in the orbit and the lifetime would give information on drag and therefore *upper atmosphere densities,* while observation of a luminous trail of sodium emitted from the satellite would allow studies of *winds, temperature,* and *turbulence* in the outermost layers of the earth's atmosphere.

[172] The technical problems connected with the launching, control and instrumentation of the MOUSE satellite are well within the range of present techniques. It is likely that even smaller satellites will be constructed first to carry out portions of the research program described above....

Introduction

It is the purpose of the present paper to present a strong justification for the establishment of a minimum artificial satellite of the earth in terms of the advances it would lead to in our knowledge of the earth's outer atmosphere, of extraterrestrial radiations and their influences on the earth. It is my belief that only after a justification has been clearly stated and the problems delineated which the [173] satellite would solve for us, does it become possible to deal with the technical problems in an intelligent manner; for example, the questions of optimum altitude of the satellite or of the precision of the orbit or of the necessary lifetime for a satellite cannot really be answered unless the purpose of the satellite is kept clearly in mind.

We will discuss here only the geophysical and astrophysical applications of a *minimum* satellite; i.e., a satellite weighing no more than perhaps fifty pounds, containing a radio transmitter and simple instruments to measure properties of the earth's atmosphere and of the extraterrestrial radiations. This does not mean that a larger satellite carrying more elaborate equipment, such as television cameras, spectrographs, or telescopes with pointing controls, would not be more useful. However, the larger satellite vehicle seems far removed from the standpoint of feasibility. To talk about its obvious usefulness would not add to the very real task of defining the usefulness of a satellite small enough so that it can be constructed and launched within the framework of available techniques. Hence we shall resist the temptation to discuss more elaborate instrumentations and consider only the very simplest types of observations which could be performed by instruments placed in a minimum vehicle above the earth's atmosphere.

Instruments vs. Propulsion

The main tasks would seem to be to decide on what is important to measure, to choose the fields in which crude observations could add appreciable knowledge to our store of information about outer space, and finally to design instruments which can without great refinement yield worthwhile and important data.

One can then investigate how the requirements of such a satellite research program affect the propulsion and guidance necessary to place the vehicle in its orbit. It is obvious that in order to be practical, this cannot be a one-way channel, but rather the propulsion engineer may say to the astrophysicist: "This is as much as we can do, so many pounds of payload, now see what you can do with that." It is necessary, therefore, to place oneself somewhere in the middle, keeping both ears open, one towards propulsion and the other towards the scientific instrumentation and to allow continuously for modifications on both sides in order to produce an end product which will be both *useful* and *feasible.*

This indeed is the heart of the compromise. It is relatively easy to produce a satellite which may be nothing more than a tiny metal slug, but it is hard to justify it on the basis of geophysical usefulness if it cannot be easily observed. On the other hand, an ambitious satellite with elaborate instruments may exceed the limitations set down by the rocket engineer. So, in order to be practical, and this paper will be concerned with a practical approach, a satellite proposal has to be both *feasible* and *worthwhile.*

We will arrange this paper into two parts: The first part will deal with a detailed discussion of the most useful investigations, and their scientific and economic implications. The second part will deal with some of the technical questions pertaining to a satellite, discussed in the light of the above investigations. These technical questions relate primarily to the weight of the satellite, to its physical dimensions, to the structural materials (in particular the skin), to the method of data recovery, to the choice of orbit, to the optimum launching altitude, to the necessary launching accuracy in speed and angle and the resulting precision of the orbit, and to the "lifetime" of the satellite.[4]

[174] Basic Reasons for Upper Atmosphere Investigations

In order to study the largest part of extraterrestrial radiations, either electromagnetic or corpuscular, it is necessary to be above the appreciable[5] atmosphere since the radiation on encountering the atmosphere is modified or absorbed. Certain of the radiations, e.g., ultraviolet from the sun, are of great importance for the behavior of the atmosphere, but in every case a study of the incoming radiations reveals much about processes in outer space which could not be determined from sea level or even balloon observations. If we examine the transmission of the atmosphere to electromagnetic radiations [1], we find only two major "windows", one in the visible region from 2900 A to about 7000 A, the other in the radio region. Beyond 7000 A in the infrared there are many absorption bands due to the presence of water vapor, carbon dioxide, and ozone. Occasionally there are "windows" in the atmosphere through which one can see small portions of the infrared spectrum of the sun [2]. A particular prominent window is in the neighborhood of ten microns. It is only when one reaches wave lengths of the order of millimeters, in the microwave region, that the atmosphere again becomes transparent. But when the wave length increases up to a few meters the waves are again prevented from coming to sea level, this time not by absorption, but by reflection from the ionized layers in the upper atmosphere [1]. Going from the optical window towards shorter wave lengths one finds ozone and oxygen to be effective absorbers of ultraviolet radiation. It is only recently that rocket flights above 70 miles have given direct evidence of solar radiation in the far ultraviolet and in the X-ray region.

The situation is even worse with regard to corpuscular radiation. Even the highly energetic ($> 10^9$ ev) cosmic ray primary particles (made up of protons and nuclei of heavier atoms) cannot penetrate far into the atmosphere without undergoing collisions with air nuclei. Only the cosmic ray secondaries produced in these collisions can reach the lower atmosphere [3]. Auroral particles, [175] which are responsible for the northern lights, may contain protons of energy 100 times lower than the lowest cosmic ray energies; they are easily stopped in the upper atmosphere as they give up their energy to excite the auroral glow [4]; strangely enough particles of energy intermediate to cosmic rays and auroral particles are often absent [5]. Particles of even lower velocity (about 3000 km/sec) are extremely difficult to detect if they arrive singly. If they are charged, they will be turned away by the earth's magnetic field, long before they come close to the atmosphere. If, however, they arrive in sufficiently large numbers, in the form of corpuscular streams, instead of singly, then their reaction on the magnetic field is noticeable and may even lead to measurable variations of the earth's field [6].

A third category includes material bodies: interplanetary dust particles, micrometeorites, meteors and meteorites. The last two categories can, of course, be detected from

4. This novel concept relates to the duration of the satellite orbit and is discussed in Part II. Astronautics, Acta, Vol. I, Fasc. 4.

5. Where "appreciable" denotes an altitude appropriate to the type of radiation under study, e.g., ~ 25 miles for cosmic rays, ~ 65 miles for solar ultraviolet.

the ground, the meteors by their luminous and ionization trails. If they are extremely small (of the order of a few microns), they may not produce these trails. They could, however, be observed in impacts with detectors placed above the atmosphere [7].

Satellite Observations

Since 1946 upper atmosphere experiments have been carried on in V-2, Aerobee, and Viking high altitude sounding rockets and have furnished a great deal of scientific knowledge about the high atmosphere and solar and cosmic radiations [8]. In a critical study of the rocket program one is left with the feeling that much could be gained in certain fields by more frequent or even continuous observations as against occasional rocket measurements at one location of the earth. Out of such a study emerges a consistent research program for a satellite, consistent in the sense that it will supplement the information which has been [176] derived from high altitude rocket experiments by expanding the time and geographical scale of certain observations. Rocket experiments, because of their greater payloads, can delve more closely into detailed investigations of upper atmosphere phenomena and radiations from outer space.

Electromagnetic Radiations

Probably the most important subject for study from a platform above the atmosphere is the ultraviolet radiation from the sun. The interesting radiations extend all the way into the soft X-ray region with wave lengths of only a few Angstrom units. The portion of the radiation extending from 2900 A to 2200 A is stopped by the ozone (0_3) of the middle atmosphere (about 30 miles). Wavelengths shorter than 2200 A must be observed at altitudes of over 65 miles since the absorption of the residual oxygen in the atmosphere is strong enough to eliminate all traces of this radiation at lower altitudes [1].

A characteristic feature of the solar radiation in the UV region is its great variability; although the sun appears to be emitting steadily in the visible, in the ultraviolet it behaves very much as a variable star. Since the ultraviolet radiation has such profound effects on the earth's upper atmosphere (it produces the radio reflecting layers of the ionosphere and the ozone layer) and since it initiates many photochemical reactions in the upper atmosphere, it is of the utmost importance to keep track of the ultraviolet radiation. Of particular interest in the Lyman-alpha line of hydrogen at 1216 A where a large part of the ultraviolet energy of the sun is concentrated. It is suspected that the intensity of the line can vary considerably depending on the amount of solar activity [9]. During periods of solar activity large amounts of energy seem to be released in the solar atmosphere and can be observed as sudden brightenings ("flares") on the solar surface in the vicinity of sun spots. These brightenings cover only a minute fraction of the solar disc and are detectable only in light filtered in the red line of atomic hydrogen ($H\alpha$ line 6563 A). During these solar flares gaseous material is ejected from the sun into interplanetary space and large amounts of electromagnetic radiation are also emitted. We cannot observe at sea level anything but the visible. There is good evidence, however, for the increased emission of UV through observations of the ionosphere. Large solar flares can produce so-called radio fadeouts which are indicated by the disappearance of reflected radio signals. The fadeouts are caused by excess ionization in the lower *D* layer of the ionosphere, this excess ionization being produced by a large increase in the UV emission from various levels of the sun's atmosphere. The outermost level, the tenuous corona, emits X-radiations which are similarly enhanced during solar flares. The exact amounts are not known and their variability is quite unknown. Probably, therefore, the most important application of a satellite would be to the study of the Lyman-alpha radiation and the X-radiation of the sun, and of their intensity variation with time during different periods of solar activity. A study of the relationship, during solar flares, of the large increases among the different regions of the solar spectrum may give us valuable information about the manner in which the energy is transferred from the surface of the sun into the sun's outer atmosphere 10,000 miles up. It is suspected that the corona is heated either by magneto-hydrodynamic shock waves or by particle streams, thus causing the high temperatures which are deduced from coronal emission lines observed in the visible. From the travel time of the disturbance we may be able to learn more about the actual mechanism by which the energy is transported in the solar atmosphere.

[177] The economic implications of these studies are quite considerable, particularly if correlated directly with ionospheric observations. The study of the ionosphere has become a vast undertaking carried on by the laboratories of many governments on an international basis in order to derive fundamental information about the radio reflecting layers. The knowledge derived can be applied in a practical way to give predictions necessary for effective radio communication. At the present time this study is handicapped by our very imperfect knowledge about the solar radiations which produce these layers. Although there can be a wide range of argument about which types of satellite observations would be the most useful, it is safe to say that the studies of the solar radiation described above would rank very high.

The instruments for observing solar ultraviolet and X-radiation can be photon geiger-counters or photo sensitive surfaces with appropriate filters, similar to techniques which are now being used in high altitude rockets [8]. It is essential, however, to be able to point the instruments roughly towards the sun, to have them reasonably omnidirectional in case of misorientation, and to be able to observe the sun over as large a fraction of the orbit as possible.

Aside from the UV region, measurements of electromagnetic radiation can also be carried on in the infrared. Here the techniques become more difficult, also the results become less important from the fundamental point of view of solar physics and from the applied point of view of atmospheric effects. Furthermore, the variability in the infrared should be low; therefore, occasional rather than continuous observation may provide the necessary answers. Finally, it is possible to get a great deal of information on the solar infrared from balloon observations above the appreciable water-vapor and carbon dioxide of the lower atmosphere.

Up to now no hard X-rays or gamma rays coming from the sun have been measured. The problem may be one of low intensity, but it is certainly advisable to explore this region in conventional high altitude rockets before discussing applications for a satellite instrumentation. Of particular interest would be the measurement of the 2.2 Mev gamma ray which arises from the radiative nuclear capture of neutrons by protons and would indicate the presence of high energy neutrons on the sun. This is an experiment which could probably be done in a balloon because high energy gamma rays are quite penetrating; thus it is no longer necessary to observe at extremely high altitudes.

Corpuscular Radiation

During periods of great solar activity, one can observe with chronographs prominences of luminous gas being shot out from the solar surface. These observations indicate the great violence of solar processes. Recent radio observations of the sun have shown the existence of streams of charged particles which are shot out through the solar atmosphere during solar flares [9]. But for a half century now it has been hypothesized that the sun can emit clouds of ionized gas with velocities high enough to leave its surface and travel through interplanetary space past the earth. While it has not been possible to observe these gas clouds directly in their travel from the sun, their effects upon the earth are unmistakable. About a day following a strong solar flare (as manifested by visual observations on the solar disk and by ultraviolet enhancements leading to radio fadeouts), one observes a sudden increase of the earth's magnetic field, the so-called "sudden commencement." This is followed a few hours later by a slow decrease of the field which may last for several days. These "magnetic storms" are world-wide and are believed to be produced by the electromagnetic effects [178] of these streams of charged particles as they enter the earth's magnetic field. During these periods one also observes a large enhancement of the aurora in the northern and southern hemispheres. These auroral displays in the upper atmosphere are thought to be due to high speed corpuscles, possibly protons, which come from the sun during these periods of great activity. The regions of the sun which are responsible for the magnetic storms, the so-called *M*-regions, show great persistence; twenty-seven days later, one synodic rotation period of the sun, one may again observe a magnetic storm, an enhancement of the aurora, and associated cosmic ray effects. It is thought, therefore, that the active regions of the sun continue to emit a stream of particles which sweeps interplanetary space, very much like a stream of water from a rotating garden hose [1].

The nature of the solar streams, and the exact mechanism by which they cause magnetic storms, aurorae, and cosmic ray effects, are not well understood. A satellite could contribute to this study in two ways: (1) By intercepting the particles which cause the aurora, we would determine their nature and their intensity, their time variations and their geographical distribution. A satellite traversing an orbit over both poles would also contain the world-wide distribution of auroral particles in the northern and southern hemispheres. This would give an important clue to their origin. (2) By studying the magnetic field above the conducting layers of the ionosphere one would obtain a better picture of the primary effects of the magnetic-storm producing beam since the magnetic effect observed at sea level is distorted by the ionosphere [7]. The instrumentation for these measurements is again well proven from high altitude rocket experiments. The auroral particle measurements could be done with thin-walled geiger-counters whereas the magnetic storm measurements could be done by means of total field magnetometers such as have been used in Aerobee rockets.

The study of magnetic storms and aurorae is of considerable practical importance again from the point of view of radio communication. Magnetic storms have sometimes profound and very violent effects also on long distance telephone communication; the electric fields induced by the strong variations in the earth's magnetic field can easily burn out long distance cables and raise havoc with wire communication.

Cosmic Rays

Cosmic rays are corpuscular radiations of extremely high energies. The primary cosmic rays consist mainly of protons but also of helium nuclei and to a smaller extent of the nuclei of heavier elements. They arrive at the top of the atmosphere with almost the speed of light and with energies ranging from a few billion electron volts (Bev) up to a billion times as much. They constitute the highest energy phenomenon known in nature; but because of the small number of cosmic rays which are received here, the energy they bring in is about equal to the energy of starlight. The effects of cosmic rays on the earth and the earth's atmosphere are, therefore, probably negligible but they constitute one of the most important fields of study in modern physics and provide a challenging problem to the astrophysicist as well as to the nuclear physicist. The nuclear physicist studies cosmic rays because they represent nuclear particles of energy vastly greater than can be produced by even the largest accelerators. The cosmic rays in colliding with the atoms of the upper air produce nuclear reactions which cannot be duplicated in laboratory studies. The nuclear physicist, therefore, views cosmic rays essentially as a tool which nature has provided to help him in the study of high energy physics and with which he hopes to solve the problems of [179] the ultimate constitution of the nucleus and the ultimate nature of the "elementary" particles. Already the study of cosmic rays from that point-of-view has led to the discovery of many new types of elementary particles, the so-called mesons. There is reason to believe that their systematic study will lead eventually to a better understanding of the nature of nuclear forces [3].

The astrophysicist treats cosmic rays essentially as a phenomenon and as an indicator of processes which go on in the galaxy and in the solar system. He is mainly concerned about the origin of the cosmic radiation and about the manner in which they acquire the high energies; he asks about the processes which exist in the universe which can produce such tremendous energies. There is little doubt that these processes are electromagnetic in nature and that, therefore, a study of the origin of cosmic rays will lead to a better understanding of the electromagnetic conditions not only in the vicinity of the earth and in the solar system but also in our galaxy. This knowledge of magnetic fields in the galaxy can have a very profound influence on theories of the origin of galactic systems and on cosmology in general.

One of the most fruitful ways of studying the cosmic radiation is to investigate the distribution-in-energy of the primary rays. This has been accomplished in rocket experiments by observing the cosmic ray flux at different latitudes. The method makes use of the earth's magnetic field, which varies with latitude, and uses this field as an energy analyzer for cosmic radiations. It has led to the rather surprising finding that in the cosmic radiation there is at times an absence of low energy cosmic rays; i.e., below about 0.5 Bev there are very few cosmic rays compared to the number above this energy [5]. The mechanism which either keeps low energy cosmic rays from coming to the earth, or perhaps prevents their ever being produced, is not understood, and if cleared up will probably shed a great deal of light on the origin of cosmic rays themselves. Experimentally this absence of low energy cosmic rays manifests itself as follows: While the cosmic ray flux increases by a factor of ten in going from the equator to geomagnetic latitude 56°, there is no further increase observed between 56° and 90°. If the low energy cosmic radiation were present, the increase between 56° and 90° might be almost another factor of ten.

The most promising method, therefore, for using a satellite for cosmic ray studies would be to investigate the energy spectrum on a continuous basis by allowing the satellite to travel between 0° and 90° latitude to measure the intensity variation of cosmic rays as a function of latitude. We would like to discover, for example, whether the "knee" at 56° is fixed with time or whether its position changes as a function of the solar cycle, whether there are increases in intensity above 56° possibly correlated with phenomena on the sun, and so on.

From cosmic ray studies of the last few years we know that the cosmic ray intensity is not constant. Among the more pronounced effects there are two which seem to be especially suited to satellite observations, because of their large size. They are the cosmic ray increases which sometimes accompany certain bright solar flares, and the cosmic ray decreases which often occur in connection with magnetic storms [3].

The cosmic ray increases associated occasionally with solar flares manifest themselves in a rapid rise of the cosmic ray intensity about ten to thirty minutes after the solar flare. It seems fairly certain that the increases are due to cosmic ray particles, accelerated either on the sun or in the immediate vicinity of the sun, which travel towards the earth and are then deflected by the earth's magnetic field. This deflection causes the particles to be incident at certain locations, the so-called impact zones, with relation to the sun-earth line [10]. From our present [180] sea level observations it seems fairly certain that these cosmic ray increases are due to additional particles of low energy, i.e., not exceeding about 10 Bev. What is quite unknown, however, is the reason why only a few solar flares cause these large increases, four in the last 15 years. Satellite observations could establish whether increases occurred in the primary cosmic rays but were confined to such low energies that no effects could be detected at sea level.

The decreases of the cosmic ray intensity lasting a day or more and associated with magnetic storms are among the most puzzling phenomena. Recent observations that these decreases occur even at the pole establish that we are dealing here with a real decrease in the cosmic ray intensity in the vicinity of the earth, rather than a deflection away from the earth by the ring current which is thought to encircle the earth during periods of magnetic storms [4]. The question as to what produces this decrease in cosmic ray intensity is not at all settled. It is thought likely that the cosmic storms are produced by the corpuscular streams from the sun which are also responsible for magnetic storms. The cosmic ray decreases show the same 27-day recurrence, clearly associated with the 27-day synodic rotation period of the sun. One of the missing links for an interpretation of the phenomenon is again an observation of the primary spectrum during periods of cosmic ray storm decreases [7].

Techniques for observing the cosmic radiation are well developed from work in conventional rockets. Geigercounters of conventional and special design could be used to measure the flux and even the composition of the primary radiation.

Micrometeorites

We cannot study atomic particles of extremely low velocities; i.e., below the velocities of auroral particles, unless they occur in large streams and produce electromagnetic effects as is the case with the corpuscular streams from the sun. We can, however, study low velocity particles of higher mass, i.e., micrometeorites or interplanetary dust particles (dimension of the order of 1 micron). Depending on their orbits with respect to the earth they may enter the atmosphere with velocities up to about seventy kilometers per second. The larger ones produce, of course, the bright flashes and ionization trails associated with meteors but very small ones may escape detection entirely. No direct observations have been made of micrometeorites except for some exploratory rocket experiments in which their impacts have been observed either by condenser microphones or by the pitting of polished plates [7].

Observations of the zodiacal light and of the F-corona, the outer dust corona of the sun, have given some ideas of the density of interplanetary dust between the sun and the earth. Micrometeorites would perhaps have the same dimensions as dust particles but travel with rather high speeds into the atmosphere. The number of observations of the interplanetary dust are not sufficient as yet to establish any significant density variations with the solar cycle or even variations of a shorter time period. A particularly interesting point to investigate would be the effect of solar corpuscular beams on the dust density; it will be possible thereby to evaluate the "sweeping out" effect of a corpuscular beam. This study of the fluctuations in their intensity could be performed in a satellite by counting particle impacts; it would have considerable value in clearing up the origin of the interplanetary dust particles. The measurement of an intensity variation vs. latitude would give information on their momenta and electric charges.

[181] **Observations of the Earth's Upper Atmosphere**

Earth's Albedo

One of the main questions which concerns meteorologists is the heat input to the earth from the sun. The heat balance of the earth can be described roughly as follows: The earth intercepts from the sun an amount of energy equal to the solar constant at the earth's orbit times the cross-sectional area of the earth. The solar constant has the value of 2 calories/cm^2/min; it is believed that variations in the solar ultraviolet emission do not affect its value appreciably although UV radiation does have profound effects on the upper atmosphere. Of the total amount of energy intercepted a certain fraction is reflected in the visible. This reflection is of the order of 35%; it is mainly due to clouds, which have a very high albedo. The albedo of the land surface is of the order of 15% although snow and ice on the land surface will greatly increase the albedo. The largest portion of the earth's surface, the oceans, have an albedo of only 4% in the visible. The net energy, i.e. incident minus reflected, is used to heat the earth's surface and atmosphere. This energy influx is balanced by the heat loss from the earth's surface and the atmosphere; they radiate according to the classical radiation laws. Since their temperature is very low, of the order of 300° K, the radiation occurs mainly in the far infrared, around ten microns. The energy is radiated isotropically into interplanetary space and is lost from the earth. The infrared loss tends to vary slowly because of the large heat capacity of the earth. The great unknown in the heat balance considerations is represented by the amount of reflected sunlight which depends so critically in the day-to-day cloud coverage of the earth. The satellite furnishes a very direct method for measuring the visual albedo of the earth and supplying thereby the vital missing link in the heat balance computations. It should, therefore, be possible to plot more detailed heat flux data for the earth, which in turn could lead to the possibility of predicting long range climate for various latitude belts of the earth and for various seasons. The practical importance of this possibility can hardly be overestimated.

The actual measurement of the earth's albedo is technically a very simple matter. A photocell which views the earth continuously would provide us with the necessary information.

Ionosphere

The radio signal from a satellite which is used to transmit the data from the various instruments can itself be used to yield important information about the ionosphere. As the satellite moves with respect to a fixed station, the total number of electrons between it and the receiving station decreases to a minimum and then increases. This change in index of refraction introduces an easily measured frequency shift. While this ionosphere frequency shift is always superimposed upon a Doppler shift, they can be separated and evaluated independently. The satellite transmitter, therefore, gives us a valuable tool for investigating the ionosphere in a manner which supplements the usual ionospheric investigations with reflected radio signals.

Upper Atmosphere Densities

The measurement of drag deceleration seems to be the only promising method for determining the densities in the very high atmosphere where the molecular mean free path is very much larger than any instrument or any vehicle which can be sent up. Clearly a vertically falling body of any appreciable mass will [182] not experience a measurable deceleration. It is only when the body travels in an orbit in which it can spend a long time in the upper atmosphere, that the product, deceleration X time, leads to an appreciable change in velocity; even though the deceleration is very small, the time interval is long enough to allow the velocity change to be measured.

In the case of a satellite the velocity change will lead to a change in the elements of the orbit; it is, therefore, possible by measuring the change in the elements of the orbit to deduce upper atmosphere densities. A detailed study of the effects of upper atmosphere drag leads to the following results: An initially elliptical orbit which has a perigee sufficiently low in the atmosphere to experience drag, will after a certain number of orbits gradually approach a circular orbit. The rate at which the eccentricity decreases depends not only on the elements of the orbit but critically on the area and mass of the satellite.[6]

6. In the elliptical orbit the energy loss occurs mainly at the perigee, the point of closest approach to the earth's surface. It is therefore possible to apply an approximation method in which the energy loss and velocity loss is concentrated at the perigee. This method can be used to predict with good accuracy the lifetime of a satellite after its initial orbit is determined and if its area and mass are known. After the orbit has become more or less circular, the energy loss will occur continuously and the circle will shrink in altitude until finally the energy loss per orbit becomes an appreciable fraction of the total energy. The perturbation method which has been used is then no longer applicable; the satellite rapidly loses altitude and intercepts the earth's surface. (For further details cf. Part II.)

Sodium Trail

It has been remarked earlier that the solar radiation produces reactions in the upper atmosphere which lead to the emission of light. Among the prominent emission lines of the night air glow are those of the "forbidden" oxygen transitions (5577 A and 6300 A) and also the yellow *D*-lines of sodium (5893 A). During twilight, while the lower atmosphere is dark, the sun illuminates the upper atmosphere. Under these conditions the few sodium atoms of the upper atmosphere, because of resonance radiation, exhibit the characteristic yellow sodium line very strongly, the so-called "twilight flash" [1]. Since the sodium atoms are not localized, the emission is observed as a diffuse yellow glow. It has been suggested that if the concentration of sodium were enhanced, the sodium light emission would be similarly increased. Therefore, a novel application of a satellite would be to exhaust sodium vapor into the upper atmosphere so as to produce a defined trail of sodium atoms which would in turn exhibit a defined trail of the sodium emission light. This would lead to rather spectacular results since it should be possible to observe this sodium trail visually from the ground during twilight conditions. From the research point of view the sodium trail offers great advantages. Since the sodium atoms are subject to collisions with other gas atoms, they will soon cool down and share their temperature. From the spreading of the trail, therefore, we would be able to learn about the temperature and turbulence in the outermost layers of the earth's atmosphere and from the distortion of the trail we would be able to deduce the existence of winds in these rarefied regions. The sodium trail certainly promises to be one of the most exciting applications of satellite geophysical research.

Technical Questions

We may now turn our attention to the characteristics of the satellite and its orbit, which are required to make possible the investigations which we have [183] outlined. With the simple instrumentation which these investigations demand, the weight of the satellite can be kept well below fifty pounds. The scientific data would be telemetered to the ground by a radio transmitter which carries superimposed on it a number of telemetering channels; each is assigned to a definite instrument which detects and transmits information about the phenomenon it is sensitive to. The largest portion of the weight will be the power supply and transmitter. Once a radio frequency channel has been established, each additional telemetering channel does not consume very much extra power or weight. The individual instrumentations probably weigh only on the order of ounces. The physical dimensions of the satellite can be similarly small, probably within a cylinder of about one foot diameter and one foot height. With proper precautions the temperature problems in the satellite are not critical; it is only necessary to establish good heat conductivity to prevent hot spots. The average temperature would be of the order of room temperature.

The various experiments outlined earlier strongly suggest an orbit [11] which will go over the poles of the earth rather than an equatorial orbit. Since, however, an equatorial orbit is easier to establish from the propulsion point of view, one probably should not insist too strongly on a polar orbit, at least to begin with, except to point out that it would allow the continuous observation of the sun and, therefore, the continuous production of electric power by means of silicon solar batteries. A polar orbit will also allow a study of the energy spectrum of the cosmic rays and the investigation of auroral particles in the auroral zone. It would further allow scanning of the complete earth's surface in order to obtain the cloud albedo. There are, therefore, many advantages in the choice of a polar orbit rather than an equatorial one; it is hoped that the additional propulsion which a polar orbit demands will not be too difficult to procure. In a polar orbit it would be most economical to store the telemetered information and release it only over the poles, either one or both, since this would demand a minimum of telemetering receiving stations. It is to be kept in mind that the orbit will stay more or less fixed in space as the earth turns underneath it. An orbit, therefore, [184] which is perpendicular to the earth-sun line, will offer the greatest advantage from the point of view of solar observation.

A question equally important as the propulsion problem is the degree of guidance necessary to achieve a desired orbit. The optimum launching altitude and the errors allowable in launching speed and angle are intimately tied up with each other and with the physical properties of the satellite. Together they determine the lifetime of the satellite. This is a matter of detailed considerations and is discussed in Part II. It is to be noted finally that optical visibility and precision of the orbit are of minor importance for a satellite whose main application is geophysical or astrophysical research. It is merely necessary to have it above the atmosphere for a sufficiently long period of time, which may mean only a few days. Astronomical perturbations can be neglected for such short lifetimes. It is seen, therefore, that the guidance and control problem, as well as the propulsion problem for this type of satellite is extremely simple [11] in comparison to satellites which are meant to fulfill more ambitious functions. It is this feature mainly which gives hope for the early accomplishment of a minimum instrumented satellite.

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Document II-12

Document title: "Memorandum of Discussion at the 322d Meeting of the National Security Council, Washington, D.C., May 10, 1957," *United Nations and General International Matters*, Vol. XI. *Foreign Relations of the United States, 1955-1957* (Washington, DC: U.S. Government Printing Office, 1988), pp. 748-54. The original document is located in the Whitman File, NSC Series, Eisenhower Library. Top Secret; Eyes Only. Prepared by S. Everett Gleason on May 11, 1957.

The National Security Council (NSC) had originally approved $20 million for the IGY satellite program, Project Vanguard. But the cost estimate for the program began rising almost immediately until it reached $110 million in April 1957. On May 3, 1957, a four-page "Memorandum for the President" from Percival Brundage, Director of the Bureau of the Budget, had raised the issue of Project Vanguard's cost overruns. This problem prompted President Eisenhower to ask that the scientific satellite program be discussed at the May 10, 1957, meeting of the NSC, including Soviet progress toward developing a space vehicle. At this meeting, the president decided that, despite the cost increases, the United States had no choice but to go ahead with the program.

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[748] In the course of his briefing [on the scientific satellite program], Mr. [Robert] Cutler [special assistant to the president for national security affairs] explained that another hike in the costs of this program had induced the President to schedule the matter for discussion by the National Security Council. Mr. Cutler said that there would be a presentation by Assistant Secretary of Defense [William M.] Holaday and other officials of the Research and Engineering Division of the Department of Defense. Dr. Detlev Bronk, President of the National Academy of Sciences, and Dr. Alan Waterman, Director of the National Science Foundation, were likewise present, and would comment on the report by the Department of Defense....

After Mr. Cutler had finished his briefing and had noted that the costs of the program had increased from the original estimate (May 1955) of $15-20 million to the estimate of April 1957, of $110 million, he turned to call upon Secretary Holaday to present the Defense Department report. The President, however, interrupted with a vigorous complaint to Mr. Cutler that before he slid over some very important facts it would be well to recall that the original [749] program, calling for six satellites, was primarily a safety program designed to assure that at least one of these six satellites could be successfully orbited. There was no intention necessarily to launch six satellites. Another problem which disturbed the President was the very costly instrumentation currently being provided for the six satellites. Such costly instrumentation had not been envisaged when NSC 5520 had originally been approved by the President. The President therefore stressed that the element of national prestige, so strongly emphasized in NSC 5520, depended on getting a satellite into its orbit, and not on the instrumentation of the scientific satellite.

Mr. Cutler explained that he had not intentionally passed over these problems, and that they would be dealt with in the presentations by the Defense Department which were now to follow. Mr. Cutler then called on Secretary Holaday, who in turn stated that Dr. [John P.] Hagen [director of the Vanguard program] would make the first report on the nature and performance of the earth satellite program and the schedule of test launchings....

Dr. Hagen was followed by Assistant Secretary Holaday, who confined himself to an analysis of the cost aspects of the program to launch an earth satellite, with particular emphasis on the reasons which had led to the marked increases in the estimated costs of completing the program. He concluded his remarks with certain recommendations as to ways and means of funding the remainder of the program.

At the conclusion of Secretary Holaday's remarks, Mr. Cutler called on Dr. Bronk for a statement of the scientific aspects and importance of the earth satellite program. Dr. Bronk said that he would divide his brief report into three main parts. He dealt first with what he described as the immediate practical values to be derived from the successful orbiting of a scientific satellite. Among these, he stressed...information on the determinants of weather; and lastly, the influence of outer space on communications. He commented on the intense anticipation with which scientists were waiting for the receipt of this kind of scientific information.

Dr. Bronk stated that the second aspect of his analysis would be concerned with what might be described as the spiritual aspects of the program. If a satellite were successfully orbited, it would constitute the movement of man into an entirely new area of the universe into which he had never moved before. This was, accordingly, a challenging adventure, and if it were successfully concluded would mark a whole new chapter—indeed, a new epoch—in science and history.

[750] Finally, Dr. Bronk said he would touch on the international aspects of the earth satellite program. These aspects, he said, were of very great concern to our scientists. The fact that our earth satellite program was being carried out in connection with the

International Geophysical Year and in association with scientific groups from many foreign countries, would bring our scientists into a relationship with the scientists of other countries which could be very significant. We are taking the lead, but we are associated with a variety of other nations.

Mr. Cutler then called on Dr. Waterman, who said he would confine himself to discussing the matter of responsibility for funding the earth satellite program, as between the National Science Foundation and the Department of Defense. The gist of Dr. Waterman's remarks was that if it proved necessary to go to the Congress for a supplemental appropriation in order to complete the program set forth in NSC 5520, the Department of Defense was in a much better position, and had a much clearer obligation, to do so than did the National Science Foundation. On the other hand, Dr. Waterman expressed the earnest hope that some way might be found to provide for the costs of completing this program without going up to the Congress with a request for supplemental appropriations.

The President said that two thoughts had come to his mind at once as he had listened to this series of reports and comments. In the first place, there was no particular reason to assume that the latest estimate of the costs of completing the program ($110 million) would prove firmer than the earlier estimates. Indeed, it was quite possible that the costs of completing the program would go to $150 million, or even higher. His second impression, said the President, was that everybody wanted to duck responsibility for finding the money to fund the program.

Mr. Cutler then requested the Director of Central Intelligence to report on what we knew about the Soviet program to launch an earth satellite, and on the world-wide effects of a U.S. decision to abandon its own earth satellite program at this time.

Mr. Dulles indicated that the Soviets had not followed through on their promise to provide the organizers of the International Geophysical Year with the appropriate details of their program,...With respect to the effect of a U.S. abandonment of our program, Mr. Dulles pointed out that the program had been widely advertised and warmly welcomed throughout the world of science. If the Soviets succeeded in orbiting a scientific satellite and the United States did not even try to, the USSR would have achieved a propaganda weapon which they could use to boast about the superiority of Soviet scientists. In the premises, the Soviets would also emphasize the propaganda theme that our abandonment [751] of this peaceful scientific program meant that we were devoting the resources of our scientists to warlike preparations instead of peaceful programs.

Mr. Cutler then invited comments from Secretary [of Defense Charles E.] Wilson. Secretary Wilson replied that when the earth satellite program was first broached in the spring of 1955, it had been clearly and publicly stated that any of the scientific information resulting from the successful launching of an earth satellite would be made available freely to the whole world. Accordingly, our earth satellite program partook of the character of a pure research product rather than of the character of directed research which the Department of Defense could appropriately describe as vital to U.S. national security. Of course, continued Secretary Wilson, we in the Defense Department do have some defense interest in the satellite program. Nevertheless, it was not the kind of program which Defense could properly underwrite and for which it could properly provide money, as it had done lately, out of the DOD emergency funds for research and development. Indeed, Congress had already criticized the Defense Department for allocating money out of its emergency funds to tide over the earth satellite program, and Secretary Wilson said he could not really blame Congressional critics for their attitude. He complained that he was already having enough trouble in providing money out of his emergency funds for research projects which were truly vital to national defense.

The Director of the Budget pointed out to Secretary Wilson that the Department of Defense Emergency Fund ran out each year and had to be renewed each year.

When Mr. Cutler inquired of Secretary [Christian A.] Herter the views of the Department of State, Secretary Herter replied that he felt much as did Mr. Allen Dulles. The State Department favored completing the earth satellite program because of the prestige it would confer on the United States. He could not speak authoritatively of the problem of funding the program, which he said did present a rather frightening picture. Asked for his opinion, Admiral [Lewis L.] Strauss, [Chair of the Atomic Energy Commission], replied that he concurred in the views of Secretary Herter.

The President then commented that there was one lesson to be learned from the experience with the earth satellite program: In the future let us avoid any bragging until we know we have succeeded in accomplishing our objectives. The President then said that he would like to be informed as to how much the increased costs of the earth satellite program derived from increased costs of more elaborate instrumentation. Secondly, he wished to inquire whether the [752] launching of an earth satellite could be rendered easier if the satellite did not contain so much instrumentation as currently planned.

In replying to the President, Secretary Holaday pointed out that the diameter of the earth satellite had been reduced from thirty inches to twenty inches, although he admitted that the instrumentation had become a little "gold-plated", or at least "chromium-plated", as it had developed. Secretary Holaday also admitted that at the start of the earth satellite program we had not realized fully the requirements of the velocity. Likewise, more observation stations were now going to be established than had originally been thought necessary. Such items as these helped to explain the increasing costs of the program.

The President responded by pointing out that although Secretary Holaday had said that the 30-inch sphere had now been reduced to a 20-inch sphere, this was still larger than the "size of the basketball" which had been mentioned when NSC 5520 had first been considered by the Council. The President confessed that he was much annoyed by this tendency to "gold-plate" the satellite in terms of instrumentation before we had proved the basic feasibility of orbiting any kind of earth satellite. Secretary Wilson added the comment that irrespective of the merit of the earth satellite program, this program had too many promoters and no bankers.

Mr. Cutler alluded to a suggestion that if we succeeded in orbiting one of the test vehicles which would have no scientific instrumentation, it might be possible to abandon the rest of the program for launching the fully-instrumented scientific satellite. The trouble with this reasoning, according to Mr. Cutler, was that the six instrumented satellites were already in the pipeline. Accordingly, if we abandoned the attempt to launch these satellites, we wouldn't save very much money and we would miss achieving our objectives.

Secretary Humphrey inquired what was expected to happen if and when we succeeded in orbiting an earth satellite. Would we not then initiate another tremendous program to launch additional satellites and secure additional information about outer space. Secretary Wilson commented that this was the likely eventuality, and that this was the American way of doing everything—bigger and better.

The President observed that it was quite conceivable that the information we achieved from the successful launching of an earth satellite would be so great as to merit a continuing program thereafter. The trouble was that our original "basketball" satellite program had grown bigger, better, and more costly, at the same time that everybody wished to duck financial responsibility for its completion.

Secretary Wilson said that there was another significant factor to account for the increasing costs of programs such as this. Whenever you put a time limit on a new and large scientific program, you [753] immediately encountered financial troubles. The costs were bound to rise if the objective had to be achieved when a specific and relatively short time interval was set.

The President observed that in any event he did not see how the United States could back out of the earth satellite program at this time. We should, however, keep it on no more elaborate a basis than at the present time. Beyond this there was the problem of how to finance the completion of the program. In this respect the President suggested that in view of the fact that we have run out of money, there was no other recourse than for Defense and the National Science Foundation jointly to appear before the Congressional committees, tell them the story, and ask for supplemental funds. Secretary Wilson agreed with the President that we could not now abandon the program, and the President informed Secretary Wilson, Mr. Brundage and Dr. Waterman that they should make arrangements to go before the Congressional committees with a request for funds to finance the program on its present basis. Before doing so, however, the President said he wished the scientists who had been concerned with this program to take another hard look at it to see if there were any ways by which the costs could be cut or minimized. The President said he was not hopeful in this respect, but that it was worth a try. Thereafter the whole truth should be presented to the committees of Congress.

Mr. Cutler said he assumed that the President wished Defense and NSF to make their joint presentation to the same committees of Congress which had been dealing with the earth satellite program in the past. Mr. Cutler also suggested that the President would wish an immediate report to the National Security Council as soon as the Defense Department has succeeded in orbiting a test vehicle.

Mr. Brundage pointed out that the President's decisions would also involve the use of $5.8 million more of the emergency funds of the Department of Defense. The President agreed, and again called for a report by the Defense Department scientists were a little more restricted in their hopes and ambitions for the earth satellite program. Secretary Wilson commented that at least such a review by the scientists might help to prevent a further elaboration of the earth satellite program.

The National Security Council:[1]

a. Discussed the subject, in the light of a presentation by the Department of Defense and comments by the Director, National Science Foundation, the President, National Academy of Sciences, and the Director of Central Intelligence.

b. Noted the President's directive that the U.S. scientific satellite program under NSC 5520 should be continued on no more elaborate basis than at present and under the following conditions:

(1) The necessary arrangements should be made with the Congressional committees which previously dealt with this program, for joint presentations by the Department of Defense and the National Science Foundation, as to:

(a) The additional funds to be made available from the Defense Department Emergency Fund to continue the program through August 1, 1957; and

(b) The additional funds which must be appropriated in Fiscal Year 1958 to the Department of Defense in order to complete the program at a total cost not to exceed $110 million.

(2) Prior to the joint presentations under b-(1)-(b) above, the scientists working on this program should again scrutinize it carefully to determine whether the estimated additional funds required can be reduced by restricting the program in ways which will not jeopardize the current objectives under NSC 5520.

(3) In addition to the report required under NSC Action No. 1656-b, the Department of Defense should submit a report to the Council immediately if one of the test vehicles is successfully orbited as a satellite.

Note: The action in b above, as approved by the President, subsequently transmitted to the Secretary of Defense, the Director, Bureau of the Budget, and the Director, National Science Foundation, for implementation....

S. Everett Gleason

1. Paragraphs a-b and Note constitute NSC Action No. 1713. (Department of State, S/S-NSC (Miscellaneous) Files: Lot 66 D 95)

Document II-13

Document title: Allen W. Dulles, Director of Central Intelligence, to The Honorable Donald Quarles, Deputy Secretary of Defense, July 5, 1957.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

By 1957, the Central Intelligence Agency was aware that the Soviet Union had an active ballistic missile program and was preparing to launch a satellite. But the exact date of the launch was still uncertain. This memorandum from Director of Central Intelligence Allen Dulles to Deputy Secretary of Defense Donald Quarles indicates that American intelligence knew a Soviet space launch was imminent, but, as of early July 1957, was still unsure of the exact date of the launch.

Dear Mr. Secretary:

Thank you for your memorandum of 20 June 1957, transmitting the letter to you from Mr. V. A. Nekrassoff.

Information concerning the timing of the launching of the Soviet's first earth-orbiting satellite is sketchy, and our people here do not believe that the evidence is sufficient as yet for a probability statement on when the Soviets may launch their first satellite.

However, data has been recently received that Alexander Nesmsyanov, President of the Soviet Academy of Sciences, stated that, "soon, literally in the next few months, the earth will get its second satellite." Other information, not so precise, indicates that the USSR probably is capable of launching a satellite in 1957, and may be making preparations to do so on IGY World Days or Special World Days. The U.S. community estimates that for prestige and psychological factors, the USSR would endeavor to be first in launching an earth satellite.

Mr. Nekrassoff's postulation of 17 September 1957, presents an interesting consideration when we note that the public releases on Vanguard project set the first launching of the U.S. satellite in 1958, and the date 17 September 1957, would permit the Russians to attain the objective of a first launching. Further, the Russians like to be dramatic and could well choose the birthday of Tsiolkovsky to accomplish such an operation, especially since this is the one hundredth anniversary of his birth. On the other hand, no IGY World Day has been established in September 1957.

Sincerely,
Allen W. Dulles
Director

Document II-14

Document title: "Announcement of the First Satellite," from *Pravda*, October 5, 1957, F.J. Krieger, *Behind the Sputniks* (Washington, DC: Public Affairs Press, 1958), pp. 311-12.

On October 4, 1957, the Soviet Union launched the first Earth-orbiting satellite to support the scientific research effort undertaken by several nations during the 1957-1958 International Geophysical Year. The Soviets called the satellite "Sputnik" or "fellow traveler" and reported the achievement in a tersely worded press release issued by the official news agency, Tass, printed in the October 5, 1957, issue of *Pravda.* The United States had also been working on a scientific satellite program, Project Vanguard, but it had not yet launched a satellite.

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[311] For several years scientific research and experimental design work have been conducted in the Soviet Union on the creation of artificial satellites of the earth.

As already reported in the press, the first launching of the satellites in the USSR were planned for realization in accordance with the scientific research program of the International Geophysical Year.

As a result of very intensive work by scientific research institutes and design bureaus the first artificial satellite in the world has been created. On October 4, 1957, this first satellite was successfully launched in the USSR. According to preliminary data, the carrier rocket has imparted to the satellite the required orbital velocity of about 8000 meters per second. At the present time the satellite is describing elliptical trajectories around the earth, and its flight can be observed in the rays of the rising and setting sun with the aid of very simple optical instruments (binoculars, telescopes, etc.).

According to calculations which now are being supplemented by direct observations, the satellite will travel at altitudes up to 900 kilometers above the surface of the earth; the time for a complete revolution of the satellite will be one hour and thirty-five minutes; the angle of inclination of its orbit to the equatorial plane is 65 degrees. On October 5 the satellite will pass over the Moscow area twice—at 1:46 a.m. and at 6:42 a.m. Moscow time. Reports about the subsequent movement of the first artificial satellite launched in the USSR on October 4 will be issued regularly by broadcasting stations.

The satellite has a spherical shape 58 centimeters in diameter and weighs 83.6 kilograms. It is equipped with two radio transmitters continuously emitting signals at frequencies of 20.005 and 40.002 megacycles per second (wave lengths of about 15 and 7.5 meters, respectively). The power of the transmitters ensures reliable reception of the signals by a broad range of radio amateurs. The signals have the form of telegraph pulses of about 0.3 second's duration with a [312] pause of the same duration. The signal of one frequency is sent during the pause in the signal of the other frequency.

Scientific stations located at various points in the Soviet Union are tracking the satellite and determining the elements of its trajectory. Since the density of the rarefied upper layers of the atmosphere is not accurately known, there are no data at present for the precise determination of the satellite's lifetime and of the point of its entry into the dense layers of the atmosphere. Calculations have shown that owing to the tremendous velocity of the satellite, at the end of its existence it will burn up on reaching the dense layers of the atmosphere at an altitude of several tens of kilometers.

As early as the end of the nineteenth century the possibility of realizing cosmic flights by means of rockets was first scientifically substantiated in Russia by the works of the outstanding Russian scientist K[onstantin] E. Tsiolkovskii [Tsiolkovskiy].

The successful launching of the first man-made earth satellite makes a most important contribution to the treasure-house of world science and culture. The scientific experiment accomplished at such a great height is of tremendous importance for learning the properties of cosmic space and for studying the earth as a planet of our solar system.

During the International Geophysical Year the Soviet Union proposes launching several more artificial earth satellites. These subsequent satellites will be larger and heavier and they will be used to carry out programs of scientific research.

Artificial earth satellites will pave the way to interplanetary travel and, apparently, our contemporaries will witness how the freed and conscientious labor of the people of the new socialist society makes the most daring dreams of mankind a reality.

Document II-15

Document title: John Foster Dulles to James C. Hagerty, October 8, 1957, with attached: "Draft Statements on the Soviet Satellite," October 5, 1957.

Source: John Foster Dulles Papers, Dwight D. Eisenhower Library, Abilene, Kansas.

The Eisenhower administration had anticipated the imminent launch of the first Soviet satellite, and had given some thought to potential public reaction to such an event. But when the launch occurred on October 4, 1957, the administration was surprised by the amount of public concern. Four days after the event, Secretary of State John Foster Dulles sent White House Press Secretary James Hagerty his suggestions for the text of a press release that would place the Sputnik launch in its proper context and reassure the public. Although Dulles' comments did not result in a press release, they did form the basis for much of the administration's "official" comment about the Soviet achievement as well as the core of President Eisenhower's comments at a press conference on October 9th. This document does not contain the draft statement prepared by Allen Dulles, Director of the Central Intelligence Agency and brother of the Secretary of State, which is mentioned in the cover letter.

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[1] Draft by JFD
10/8/57

The launching by the Soviet Union of the first earth satellite is an event of considerable technical and scientific importance. However, that importance should not be exaggerated. What has happened involves no basic discovery and the value of a satellite to mankind will for a long time be highly problematical.

That the Soviet Union was first in this project is due to the high priority which the Soviet Union gives to scientific training and to the fact that since 1945 the Soviet Union has particularly emphasized developments in the fields of missiles and of outer space. The Germans had made a major advance in this field and the results of their effort were largely taken over by the Russians when they took over the German assets, human and material, at Peenemünde, the principal German base for research and experiment in the use of outer space. This encouraged the Soviets to concentrate upon developments in this field with a use of [2] resources and effort not possible in time of peace to societies where the people are free to engage in pursuits of their own choosing and where public monies are limited by representatives of the people. Despotic societies which can command the activities and resources of all their people can often produce spectacular accomplishments. These, however, do not prove that freedom is not the best way.

While the United States has not given the same priority to outer space developments as has the Soviet Union, it has not neglected this field. It already has a capability to utilize outer space for missiles and it is expected to launch an earth satellite during the present geophysical year in accordance with a program which has been under orderly development over the past two years.

The United States welcomes the peaceful achievement of the Soviet scientists. It hopes that the acclaim which has resulted from [3] their effort will encourage the Soviet Union to seek development along peaceful lines and seek to enrich the spiritual and material welfare of their people.

What is happening with reference to outer space makes more than ever important the proposal made by the United States and the other free world members of the Disarmament Subcommittee. I recall my White House statement of August 28 which emphasized the proposal of the Western Powers at London to establish a study group to the end that "outer space shall be used only for peaceful, not military, purposes."