

National Academy of Sciences
2101 Constitution Avenue, N. W.
Washington 25, D. C.

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Detection of Life on Other
Planets: Lederberg J

SPACE SCIENCE BOARD

April 13, 1959

MEMORANDUM - SSB-77

To: Members, Space Science Board
Members, Committee on Space Projects
Members, Committee on Psychological and Biological Research

From: R. C. Peavcy, Secretary

Subject: Report by Dr. Joshua Lederberg on the Problem of
Extraterrestrial Contamination

The enclosed material has been received from Professor Joshua Lederberg of Stanford University. At the suggestion of Dr. Rossi, he has been responsible for several conferences of interested scientists on the West Coast where the problem of extraterrestrial contamination has been considered. You will note that three projects are proposed by the group, at least two of which seem appropriate for the Board to sponsor.

These proposals will be a topic of discussion at the next Board meeting, May 7-9. It is hoped that the comments of Committees 6 and 11 can be available to the Board at that time.

CC: Odishaw ←
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Preliminary studies on Planetary Biology

At the request of Prof. Bruno Rossi, acting for the NAS Space Science Board, Prof. Joshua Lederberg convened a group of biologists at West Coast universities to review some problems of policy in the space research program (particularly biological contamination), to suggest some tangible experimental approaches to the detection of life on other planets, and to stimulate broader interest on the part of biological scientists generally so as to evoke further proposals for experimentation. This group has met on two occasions so far; February 21, 1959 (Stanford) and March 21, 1959 (Jet Propulsion Labs., Pasadena); a next meeting is scheduled for May 3, 1959 (Hopkins Marine Station of Stanford University, Pacific Grove). In addition to the members listed below, we have had representatives from the Stanford Research Institute, and from JPL and NASA (A. Hibbs and R. Davies). We have reported to the NAS through Rossi and Odishaw at the Washington office, and to NASA via Hibbs and Davies, and also by letter to Jastrow (on the lunar exploration working group at NASA headquarters). We have also reported to COSPAR (CETEX) by correspondence with Hughes and with Peter Alexander. A jargon, self-indicated name for our group has been 'WESTEX'. Its university members have been: (1) signifies one mtg. attended.

U. of California (Berkeley):	U. of Cal. (Davis):	U. of Oregon:
Calvin Chemistry	Marr Bacteriology	Movick Biophysics
Mazia(1) Zoology	(La Jolla):	Cal. Inst. of Technology:
Stanier(1) Bacteriology	Urey (1) Chemistry	Morowitz Biology
Stent Virology		Stanford University:
Weaver Astronomy		Van Niel Microbiology
		Krauskopf Geochemistry
		Lederberg Genetics
		(recorder)

The composition of the group therefore reflects a balance between diversity of interest and locale and compactness of size, and convenience of assembly. Doubtless we could profit by special talents of other members, but the group should not be enlarged to the point where frequent and easy assembly becomes difficult, or where frank and casual discussion is inhibited.

While many members doubtless came to the first meeting with some sense of amusement and frivolity, it is obvious that the group as a whole is anxious to devote itself to tackling the problems of biological exploration with earnest endeavour. Many of its members are recognized as leaders in their own scientific fields, and in their academic communities. They have many other responsibilities. Nevertheless, there was unanimous enthusiasm for the continuation of its studies, and for meetings at relatively frequent intervals for mutual education and discussion. For this purpose, and to bridge the gap between exploratory discussions and preliminary experiments on one side, and tangible proposals and instrumentation for payloads on the other, we will require a substantial measure and continuity of financial support. In this proposal, several grades of support are indicated for more and more comprehensive activities. While the least and largest items might be deferred pending the elaboration of more explicit proposals, we should have prompt verification of support for our current discussions.

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Minutes of Westex's first meetings, are appended. The first meeting (Westex-1) was mainly devoted to problems of policy in celestial contamination, in view of urgent needs for the CETEX-COSPAR meetings. In brief we concluded that a basic policy of rigorous decontamination of space probes was both essential and feasible, -- modern methods of sterilization having been overlooked in other discussions. At the second meeting, this policy was reaffirmed. We then heard from Sinton on infra-red reflection spectra of Mars, which have furnished virtually conclusive evidence for 'vegetation'. We are digesting a number of ideas for improving the quality of this type of information from 'safe' (viz. distant approaches), and this will doubtless be the main topic for the near future. Finally we have in mind the careful preplanting of

experiments based on 'soft landings', especially on Mars, predicated these for about 1965. This will allow somewhat over two years for decisions on the most efficient types of experiments, leaving an equal length of time for the development and testing of the corresponding instrumentation. This timetable while not oppressive still does not allow for an indefinite waste of time. If properly supported, perhaps this might be one program that can be pursued with reasonable diligence and care rather than frantic haste. There is of course the possibility that the schedule may be accelerated (or delayed) by unforeseen technical factors, or by the pressure of international competition. Specifications for the vicinal probes are perhaps already under substantial pressure of time.

NAS might help us out on (A) and (B); together it would be inappropriate for (C).

The precise form of the support might be discussed later; from my standpoint a simple grant to Stanford University for the purposes indicated would be the most expeditious.

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Enclosure from a letter to Dr. Hugh Odishaw from Professor Joshua Lederberg, Stanford University, dated March 25, 1959, distributed to Space Science Board members in SSB #77

Proposal: Westex (A)

Travel, Communications for continued meetings of the Westex Group. \$6,000 per year.

This is based on holding about 10 meetings per year at various locations. There is a substantial advantage in meeting at different places, not only for the convenience of its peripheral members, and to help assure their attendance, but also to make further contacts with other local scientists.

While the travel costs are reduced by our regional grouping, this rather facilitates our meeting more often and more effectively for a given appropriation. In addition, there are substantial telephone charges for related business -- the more so to make the most effective use of frequent meetings. It is likely that not every member will be able to attend every meeting. On the other hand we would profit greatly by being able to invite occasional distant 'consultants' -- e.g. Fred Sinton at Westex-2. Admittedly, the development of a field as novel (in the U.S.) as astrobiology requires some expense for just the education of the workers who may participate in it.

If permissible, some of these funds (actually an insubstantial sum) should be available for the purchase of reference materials for the use of Westex members. On the other hand, at this stage, the time of Westex members is made available without cost other than expenses.

Westex (B) \$7,500 one year only

Preparation and Publication of background information: "Handbook of Planetary Biology"

From the first discussions with Dr. Rossi, it has been evident that a critical requirement for the participation of U. S. biologists in space research is the collection of background information in a convenient form. This would include resumés of the Westex and 'Eastex' meetings, the essentials of present and prospective vehicle capabilities, and the environment (in the vehicle) for experimentation, and a critical discussion from the biologist's standpoint of available information on the environment of interplanetary space and the various planets. Most of this information can be found in the astronomical and other literature, but we know from our own experience how difficult it is for a biologist, who has not given much previous thought to extra-terrestrial science, to acquire this background. For example, many of our colleagues still believe that the capability for planetary probes is decades

away (which, hopefully, is not true) so that it would be pointless for them to attend to this challenge. While some member of CETEX may be able to rob the time from his other duties to prepare such resumés, this really is a substantial job, and there is some problem in finding a sufficiently informed enthusiast to do the work. Fortunately Mr. Carl Sagan may be available for some months this summer, and perhaps again after he completes his dissertation in astronomy (planetary atmospheres) at the Yerkes Observatory. A proposed budget would be \$4,000 for a (part-time) salary to Mr. (later Dr.) Sagan as consultant to Westex, plus \$3,500 for incidental costs in secretarial work, duplication, travel, reference materials. Mr. Sagan might have several functions: a) in the preparation of the consolidated reports of Westex (and, with their approval) Eastex for, perhaps, journal publication; b) as an adviser to Westex, particularly in the review of existing literature, and c) in the preparation of the more extensive handbook. This might have some 60-100 pp. The means of its dissemination is open to further discussion -- either informal distribution to some few hundred leading scientists, as a mimeographed bulletin, or publication by NASA or by a commercial publisher (which should not be difficult to arrange, if this is the best course).

Westex (C) Exploratory experiments. \$10,000 -- 50,000

The design of payload instruments will have to be backed up by a substantial amount of laboratory work, since the analytical methods are limited by restrictions on weight, closeness of approach, automation, and the communication bandwidths. For example, there is relatively little published information on infrared reflection spectra of various materials, as would be comparable to Sinton's measurements on Mars. Before any member of Westex commits his own time and resources, to the point of preparing a detailed proposal of laboratory work involving large scale support, some exploratory observations should be made in one or another laboratory, or perhaps most conveniently on a subcontract basis with some institution such as Stanford Research Institute. For example, the evaluation of Sinton's work, and its use as the basis for vicinal probes, would be greatly facilitated by the measurement of diffuse reflection spectra from model spheres coated with various substances (e.g., cellulose; pastes of photosynthetic bacteria). Unquestionably many similar questions will arise (and have arisen). It would be most expeditious if funds were available to help support exploratory trials on points which arise in our discussions. While, in terms of this proposal, these would be administered by one responsible grantee (Stanford University) it is understood that these would be available for expenditures at other institutions as will give the most expeditious results in these preliminary stages. Further development will be on the initiative of a scientist who undertakes the responsibility for pursuing a particular program, and will prepare his own budget request for this.

The scope of these explorations will probably be influenced by the funds that NASA is prepared to offer for them. I can visualize effective use of at least \$10,000 per year for a rather limited scale, or perhaps \$50,000 if we can have some leeway in purchase of equipment and in preliminary instrumentation towards payload designs. Any more extensive expenditures

should certainly be made on the basis of explicit projects, following these explorations. These are, of course, uncommonly expensive as they require the development of new equipment modifications; in any case, even commercially available equipment in the particular field of molecular spectroscopy is far from inexpensive.

D. Possible Stanford Projects.

This is a preliminary statement concerning the possible continuation of Sagan's present work after he completes his dissertation at Yerkes. He has been studying the spectra of the major planets and is interested in the identification of some lines with more complex molecules, e.g., amino acids, as must be expected to be formed photochemically on the basis of Miller's experiments. He is interested in further model experiments on the extent of organic accumulation, especially in gravitational fields -- which has an important bearing on the possibility of organic sediments, e.g., under the Jovian oceans. This is precisely the same work as is needed to support experimental designs in ultimate probes to these planets, and it fits very closely with the Martian models, in which he is no less interested. I would propose to use the opportunity of Sagan's work as a consultant to Westex (proposal B) to lay the groundwork for a more detailed proposal. This would doubtless appear as an application over his own signature as responsible investigator, though I would support this in every way possible.

This statement is made to illustrate one way in which interim support for our group can help to build up momentum for research in planetary biology.

As concerns my own participation, apart from recording these conferences and exciting the interest of my (sometimes still diffident) colleagues in biology, I would feel most at home in any personal laboratory work in contact, rather than vicinal, experiments. If we develop an international policy of space exploration that assures an uncontaminated field of exploration, I should be interested in developing techniques of cultivation and assay for use with soft landings. In view of the indicated timetable, I would not need special financial support for another two or three years, especially if some exploratory resources are available from proposal C.