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FINAL REPORT

on

SPACE LIFE SCIENCES PILOT USER DEVELOPMENT PROGRAM FOR THE MIDWEST REGION

Contract No. NAS 9-15504

January 1, 1978 - July 31, 1978

to

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER

July 27, 1978

(NASA-CR-151819) SPACE LIFE SCIENCES PILOT USER DEVELOPMENT PROGRAM FOR THE MIDWEST REGION Final Report (Battelle Columbus Labs., Ohio.) 978-29723

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
INTRODUCTION

The Biosciences Payloads Office of the Directorate of Life Sciences, Johnson Space Center, has initiated a pilot program in several regions of the United States to promote the use of space for research by the life science community. Battelle Columbus Laboratories (BCL) has participated as a contractor in the midwestern region - covering Ohio and several surrounding states. Battelle has pursued NASA's overall program objective through a series of informal one-day seminars with personal follow-up as circumstances dictated.

The programs were planned to

- Describe the space shuttle vehicle and some of its intended uses
- Discuss problems of manned space flight
- Stimulate ideas for biological research in space
- Discuss costs and potential for industrial and government sponsorship
- Show the researcher or corporate planner how to become an active participant in Life Sciences Research in Space
Two seminars have been held to date at our facilities in Columbus, Ohio.

**METHOD**

The regional seminar approach was chosen by Battelle as the most cost effective, yet personal way of initiating information exchange with the researcher (or manager).

Drawing upon BCL's experience in STS user development and life sciences research, as well as its familiarity with the interests and activities of other scientists in the midwestern life sciences community, we determined that most potential users were concerned with the following:

- What is the space Transportation system?
- How can it be used for life sciences research?
- What are some relevant experiences?
- How do I obtain sponsorship?
- What are the costs?
- Where do I start?

The regional seminar forms a basis for information exchange designed to provide answers to these questions.

**Seminar Topic Plan**

First, we established a general program topic plan to inject continuity into the seminar series; the following outline has been used to formulate the first two seminar programs.

**A. Space Transportation System**

1. History
2. Payloads
3. Mission plans
4. NASA goals
B. Man in Space
   (1) Adaptability
   (2) Limitations
   (3) Problems
   (4) Man/Equipment interface

C. Research in Space
   (1) Space environment
   (2) Accomplishments in the life sciences
      (a) plant and animal biology
      (b) biomedical experiments
   (3) New ideas

D. Benefits from Space Research
   (1) to manned spaceflight
   (2) to life on earth
   (3) to business

E. Cost
   (1) Shuttle payload user charge policy
   (2) Sponsorship
      (a) NASA
      (b) other Government agencies
      (c) Industry
         (1) return on investment
         (2) proprietary rights
      (d) Cost sharing

F. How to Begin
   (1) Define specific research interests and objectives
   (2) Determine experimental needs and technical problem areas
   (3) Look closely at separation, transport or growth processes
   (4) Could these be altered or enhanced by Ø g or other aspects of the space environment?
   (5) Communicate with persons knowledgeable of space research in your field of interest
   (6) Use NASA's Space Life Sciences Archival Library (Biomedical and bioengineering into derived from manned space flight programs).
From these topics a series of seminars could be planned, each one somewhat different but repeating a common theme, "Life Sciences Research in Space - the Shuttle Era".

**Seminar Organization**

Two regional seminars were held at Battelle's Columbus Laboratories, utilizing our Teleconference Facility. This facility, with a capacity of 50 persons, is outfitted with several ceiling-mounted, remote controlled TV cameras, permitting unobtrusive continuous video taping of the seminar proceedings.

Dates for the seminars were chosen so as to avoid conflict with other meetings and society activities, thereby maximizing our attendance. Seminars No. 1 and 2 were carried out on March 9, 1978 and June 15, 1978, respectively. Speakers on specific topics were invited from NASA, other Government agencies, universities and colleges, and from industry-including Battelle. We encouraged the use of audio-visual aids such as slides, viewgraphs and films. Additionally, scale models of Space Shuttle Orbiter and Spacelab were brought in as conversation pieces, and selected publications were provided as hand-outs (see Table 1).

The seminars ran for one day only and were planned with ample free time for questions. It was our desire to maintain an air of structured informality and to encourage audience interaction.

All portions of the seminars were video-taped; we plan to have individual talks and edited versions of entire meetings available for distribution (later) on a loan basis if sufficient demand is shown. Programs for these two seminars are included in Appendix A and B.

**Regional Contacts**

Seminar invitations were offered by phone, mail or personal contact; where genuine interest was shown, follow-up contact continues to be maintained. Invitees included persons from Ohio and several surrounding states, representing:
TABLE 1. FILMS AND PUBLICATIONS UTILIZED

FILMS

- SPACE TRANSPORTATION SYSTEM
- BIOLOGICAL APPLICATIONS IN SPACE

PUBLICATIONS

- NASA SP 407  SPACE SHUTTLE
- ESA SP 1001  SPACELAB USERS GUIDE
- NASA  BIOPROCESSING IN SPACE
- JSC - 12599  THE SHUTTLE ERA -- SPACE SHUTTLE FACT SHEET
- BIOSCIENCE  OPPORTUNITIES FOR BIOLOGICAL RESEARCH IN SPACE
  REPRINT  DURING THE 1980's, JOHN A. MASON
- JSC - 10933 (b)  SPACE LIFE SCIENCES ARCHIVAL LIBRARY USER'S GUIDE
- NASA  SMALL SELF-CONTAINED PAYLOAD PROGRAM
- NASA  SPACE TRANSPORTATION SYSTEM USER INFORMATION SERVICES
- AIAA  SPACE - A RESOURCE FOR EARTH
- NASA-JSC  SPACE TRANSPORTATION SYSTEM USER HANDBOOK
  (limited distribution)
- JSC - 13979  BIOSPEX - BIOLOGICAL SPACE EXPERIMENTS
  A SUMMARY OF LIFE SCIENCES EXPERIMENTS CARRIED
  ON U. S. SPACECRAFT
- AO No. 05S-1-78  ANNOUNCEMENT OF OPPORTUNITY, LIFE SCIENCES INVESTIGATIONS
  ON SPACE SHUTTLE/SPACELAB MISSIONS, 1981-1983
• Industrial firms
• Academic institutions
• Research institutions
• Government agencies

An active file of interested researchers and managers was maintained and enlarged continually as new contacts were made through (1) peer referral, (2) displays and informal discussion at meetings, (3) review of source documents (e.g. society membership lists), and (4) referral and screening of relevant mailing lists. The file is computerized and can presently generate either a printed list or mailing labels. On command, it will printout according to either selected status codes or zip codes. Provision has been allowed to select lists later by scientific field, company, agency or university affiliation, or other key phrases.

Peer Referral

Our initial contacts were referred by Battelle research staff in the life sciences as well as by our marketing staff. This group continues to enlarge as new contacts are made in the course of our daily activities.

Meeting Attendance

Posters and hand-out materials were used on several occasions to promote the regional user development program. Also, opportunity was given to present and/or discuss the program at several meetings.

4-17-78 Battelle Operations Management Meeting; Columbus, Ohio
4-29-78 International Biomaterials Symposium; San Antonio, Texas
5-12-78 International Conference on Cell and Molecular Biology in Space; Toledo, Ohio
5-16-78 Research Forum - Riverside Methodist Hospital; Columbus, Ohio
5-30-78 American Institute of Aeronautics and Astronautics; Columbus, Ohio
6-27-78 Central Ohio Medical Equipment Technicians Assoc; Columbus, Ohio
Source Documents

Many contacts were established through the use of reference materials obtained from Battelle's Library and Marketing facilities, and from individual researchers. Initially the following were reviewed, in part:

3. Membership list, Society for Biomaterials
4. Membership list, American Society for Physiologists

Many such publications could be screened for expansion of the mailing list, including Moody's Industrial Manual, NIH Research Grants, the Who's Who (in science) series, and additional professional society listings.

Referred Mailing Lists

Also considered were specific interest groups other than professional societies, such as those attending special meetings on related scientific topics. We were fortunate to obtain from Dr. Bodo Diehn (University of Toledo), the pre-registration list for the International Conference on Cell and Molecular Biology in Space, which took place May 10-12, 1978 in Toledo, Ohio. Many beneficial contacts resulted from the use of that list.

Other Contacts

Several persons now listed in our file were "second generation" contacts, referred by friends/peers who had been informed directly concerning our regional seminars. In essence our promotional program networked itself through word-of-mouth referral.

Follow-up Activities

Once interest is generated (through the seminar program), it must be maintained in order to nurture ideas and to ultimately enlist participation in the space program. This was accomplished by first determining each researchers specific areas of interest, and the depth of their experience
(if any) with NASA and the space life sciences program. A seminar follow-up survey and personal discussion were means for obtaining this information. We asked for information concerning previous space program involvement, present proposal activity, new areas for development, anticipated problems concerning research in space, and information requirements. A survey form (included in the Appendix) was mailed to seminar attendees, along with a registration list, speakers roster, and any specific information requested during the seminar. A prepaid business reply envelope was provided to minimize response effort.

Attendees were encouraged to maintain open communication with Battelle; subsequently, we provided additional background information or referred inquiries to NASA personnel on several occasions. Although funds did not permit during this initial effort, some university and industrial groups have asked for future briefings at their location.

RESULTS

The numerous contacts (222) established during the course of this contract have hopefully stimulated many creative researchers and forward-looking managers into thinking "space" and how they and their organizations can utilize the Space Transportation System to accomplish their goals. Most persons contacted were genuinely interested in the space program, but in some cases there was no fit with the objectives of their organization. As a clear show of interest, 209 persons remain on our mailing list.

We are especially grateful to the invited speakers, who made the two seminar programs an obvious success.

- George T. Brooks - National Institutes of Health
- William J. Clarke - Battelle Columbus Laboratories
- Ronald B. Hoffman - General Electric Company
- Phillip C. Johnson - Baylor College of Medicine
- Paul D. Klimstra - G. D. Searle and Company
- John A. Mason - NASA, Johnson Space Center
- Jack R. McDowell - Battelle, Columbus Laboratories
Following our general topic plan outlined earlier, the first seminar was structured to cover (1) STS and the Space Shuttle, (2) payloads and user charge policy, (3) man in space, his problems, limitations and contributions, (4) research experience with cellular systems, (5) new ideas for life support in space, (6) industrial sponsorship of space research and, (7) using the Space Shuttle. Full program details are included in Appendix A.

The first seminar, held March 9, 1978, was arranged wholly through telephone contact. Once arrangements for the program and attending speakers were firm, 65 contacts obtained by peer referral were telephoned; the seminar and our objectives were described in detail. From these 65 calls, 44 firm commitments were made, of which 39 actually attended.

Representatives came from:

(1) Battelle Columbus Labs
(2) State of Ohio
(3) Ohio State University Hospitals
(4) Ohio State University Research Foundation
(5) Ohio State University
(6) Nationwide Corporation
(7) Wright Patterson Air Force Base
(8) Antioch College
(9) University of Cincinnati
(10) Charles F. Kettering Research Lab
(11) Adria Labs.
(12) Ross Labs.

(see full attendance list, Appendix A).
Seminar No. 2

Bearing some similarity to the first seminar, the second program, held June 15, 1978, was modified to include (1) STS and the Space Shuttle, (2) payloads and user charge policy, (3) experimental equipment for use in space (4) man in space, his physiological response, (5) experience with plant physiology experiments for Spacelab, (6) potential for sponsorship of space research by the National Institutes of Health, and (7) using the Space Shuttle. Again, full program details are included in Appendix B.

Invitations for the second seminar were mailed to 184 persons, additionally a number of contacts were established at the various meetings which were mentioned earlier. Resultant confirmations for preregistration included 51 persons, 38 of whom attended the seminar. Represented were:

1. University of Kentucky
2. State of Ohio
3. Battelle Columbus Labs
4. University of Louisville
5. Columbus (Ohio) Public Schools
6. Ohio State University Research Foundation
7. Ohio State University
8. Case Western Reserve University
10. Research Triangle Institute
11. University of Cincinnati
12. University of Toledo
13. (Columbus) area physicians
14. Wright Patterson Air Force Base
15. University of Maryland
16. Roswell Park Memorial Institute

(see full attendance list, Appendix B).
Promotional Materials

All of the materials used - including publications, films, posters, spacecraft models, seminar announcements and reply cards - proved to be invaluable aids in promoting and carrying out the two seminars.

A frequent newsletter, issued by NASA and covering current events on life sciences research could be an asset. Also, researchers expressed a desire to know more about available experimental equipment and changes in physical phenomena expected in space. NASA's recent release of "BIOSPEX: Biological Space Experiments" contains excellent information on research experience to date, and should prove to be extremely useful to researchers.

Survey Response

A seminar follow-up survey was mailed to attendees of each seminar program (see Appendix C). Responses to that survey are tabulated here in summation; the following figures are based on information derived from the 38 survey forms which were returned; this represents about 50% response.
<table>
<thead>
<tr>
<th>Item</th>
<th>Response*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you now receive NASA announcements of opportunity (AO)?</td>
<td>Yes: 14</td>
</tr>
<tr>
<td></td>
<td>No: 23</td>
</tr>
<tr>
<td>May we refer your name to NASA for future mailings of AO's, newsletters, etc.?</td>
<td>Yes: 35</td>
</tr>
<tr>
<td></td>
<td>No: 1</td>
</tr>
<tr>
<td>Did the Seminar stimulate your interest in research in space?</td>
<td>Yes: 33</td>
</tr>
<tr>
<td></td>
<td>No: 2</td>
</tr>
<tr>
<td>Have you ever worked with NASA</td>
<td>Yes: 15</td>
</tr>
<tr>
<td></td>
<td>No: 23</td>
</tr>
<tr>
<td></td>
<td>No: 10</td>
</tr>
<tr>
<td>Do you intend to submit a proposal to NASA for flight experiments under this AO?</td>
<td>Yes: 11</td>
</tr>
<tr>
<td></td>
<td>No: 17</td>
</tr>
<tr>
<td>Will you need assistance in understanding the AO and Proposal Requirements?</td>
<td>Yes: 4</td>
</tr>
<tr>
<td></td>
<td>No: 7</td>
</tr>
<tr>
<td>Would you like to develop an experiment for research in space?</td>
<td>Yes: 26</td>
</tr>
<tr>
<td></td>
<td>No: 5</td>
</tr>
<tr>
<td>Do you need more information on:</td>
<td>Yes: 14</td>
</tr>
<tr>
<td>related experience</td>
<td></td>
</tr>
<tr>
<td>experimental equipment</td>
<td>Yes: 13</td>
</tr>
<tr>
<td>physical phenomena</td>
<td>Yes: 5</td>
</tr>
</tbody>
</table>

* Total Survey Response 38.
In addition, the survey included 2 subjective questions; the responses are listed below at random.

**What problems/limitations do you envision in carrying out life sciences research in space?**

1. Interfacing with NASA centers
2. Meeting flight requirements
3. Financial
4. Time and funding for equipment development
5. Inability to make changes during course of experiment
6. Duration of experiment limited by mission time
7. Better understanding needed between NASA and other potential sponsors
8. NASA has not supported the scientific community adequately, after gaining their interest
9. Transfer of technology to earth applications
10. Disposal of organic solvents
11. Acceleration of launch and re-entry
12. Planning experimental period to coincide with actual time of weightlessness
13. Wall effects of containers
14. Maintenance of sample viability before and after experiment, especially pre-launch and post-recovery
15. Interface with NASA concerning hardware design and fabrication
16. Limited space availability
17. Maintaining biological materials during pre-launch and launch
18. Circulation of fluid media without nulling the benefits of weightlessness (e.g. in culture systems)
19. Long-term return on research investment
20. Experimental continuity may suffer due to limited funding and flight opportunities
21. Difficult for researchers to think in terms of 0-gravity, help needed in understanding basic physical phenomena of the space environment
22. Funding: NASA should provide adequate debriefing for proposals
23. Appropriate animal housing units and facilities for sufficiently large numbers of animals
24. Time limitations (crew) in carrying out laboratory procedures in space
25. High cost of developing and producing specialized equipment
26. Experiment containment
27. Need for ground-based research prior to the design of an experiment package for space flight
28. Room to house enough animals per experiment to allow statistical analysis
29. Obtaining sponsorship
30. Administrative red tape.

It is obvious from these remarks that researchers are concerned about:

<table>
<thead>
<tr>
<th>% of responses</th>
<th>Technical problems</th>
<th>Experiment planning</th>
<th>Proposal acceptance</th>
<th>Technology transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>27</td>
<td>23</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

What subject areas would you recommend for study in space? (by yourself or others)

1. Crew health
2. Passenger selection criteria
3. Physiological mechanisms
4. Reproductive processes (2)
5. Deconditioning countermeasures
6. Metabolism
7. Central nervous system (behavioral)
8. Cardiovascular/renal physiology
9. Cardiovascular dynamics
10. Pharmacology
11. Arterial endothelium
12. Enzyme kinetics
13. Algal growth and life cycles
14. Biomass production
15. Maximum photosynthetic rates
16. Plant growth and form over extended periods (2)
17. Cell biology (2)
18. Tumor immunobiology
19. Fluids and electrolytes transport
20. Properties of fluids
21. Microencapsulation
22. Controlled release from microcapsules
23. Transcervical migration of microcapsules
24. Photosynthesis
25. Solar batteries based on photosynthesis
26. Basic study of transport in plants
27. Space sickness
28. Calcium metabolism
29. Developmental biology (3)
30. Biological cycles (2)
31. Development of fluid suspension processing equipment
32. Containerless processing
33. Mammalian development
34. Long-duration closed cycle systems
35. Mutagenesis
36. Cell culture
37. Embryology
38. Embryo polarity
39. Morphogenesis of plant embryos (2)
40. Plant tissue culture
41. Cellular level responses
42. Basic research on usefulness of space
43. Pulmonary physiology
44. Growth and morphogenesis of isolated plant organs
45. Hormone and drug actions in cell cultures (2)
46. Simulation verification
47. Interaction of host and endogenous/exogenous zoopathogens, as influenced by suppressed immunologic state of crew
48. Microbiology
49. Recombinant DNA
50. Artificial photosynthetic systems for life support in space
51. Bacteriorhodopsin (purple membrane) as a model for human visual membranes
52. Neuro-behavioral effects of prolonged space flight on animals born in space
53. Development neurobiology
54. Plant nutrition
55. Mycology
56. Vestibular/circulatory physiology
57. Mammalian enzymes

Proposals in Process

Among the survey forms returned were 11 which showed a positive response to the question, "Do you intend to submit a proposal --- under this AO?" (No. OSS-1-78, dated Feb. 7, 1978). The subject areas indicated and investigators are:

1. Cardiovascular Deconditioning
   Amit Bhattacharya
   Univ. of Kentucky
   Lexington, Kentucky

2. Vestibular system
   David L. Clark
   Ohio State Univ.
   Columbus, Ohio

3. Electrolytes Transport
   Mumtaz A. Dinno
   Univ. of Louisville
   Louisville, Kentucky

4. Developmental Biology/Biological Cycles
   Ronald B. Hoffman
   General Electric Co.
   Houston, Texas

5. Development/Embryology (2 proposals)
   J. Richard Keefe
   Biospace Inc.
   Painesville, Ohio

6. Developmental Neurobiology
   Alan Kolber
   Research Triangle Institute
   Research Triangle Park, North Carolina

7. Developmental Biology
   Maurice Lalonde
   Charles F. Kettering Research Laboratory
   Yellow Springs, Ohio
Battelle Columbus Laboratories has participated as a regional contractor (Midwest) in a pilot program to promote the use of space for research by the life sciences community. This program has been sponsored by the Bioscience Payloads Office of the Directorate of Life Sciences, Johnson Space Center.

Following a general topic plan, two regional seminars entitled "Life Sciences Research in Space - the Shuttle Era", were held at Battelle's facilities in Columbus, Ohio to introduce area researchers to the Space Transportation System, its capabilities and potential applications. Each one-day program was centered on a group of invited speakers who discussed various aspects of NASA's space program and the opportunities for biological research in space. Contacts were established with 222 persons in various academic, industrial and government organizations generally within Ohio and the neighboring states. The particular seminar topic plan we have chosen seems to spark interest in the majority of researchers contacted,
especially when discussed in person. The two seminars, March 9 and June 15, 1978, were attended by 39 and 38 persons, respectively.

It appears that the life sciences research community is excited about the potential for space research, but generally naive regarding (1) the space shuttle vehicle, its various payloads and NASA's mission plans for them, (2) the space environment, changes in physical phenomena and their effects on man and his experimental methods, (3) NASA's key areas of interest, space research experience and potential for sponsorship of new ideas (by NASA or others), and (4) how to get involved in space life sciences research.

Persons (38) responding to a follow-up survey indicated that (1) only 1/3 regularly receive NASA Announcements of Opportunity, (2) 2/3 have never worked with NASA, (3) the seminars did stimulate interest in research in space, (4) 11 were intending to submit proposals for A.O. No. OSS-1-78, (5) 4 of these asked for assistance in understanding the AO and proposal requirements, and (6) 26 additional persons expressed an interest in developing an experiment for research in space. Many indicated a need for information on related experience and experiment equipment, while a lesser number were interested in physical phenomena.

Thirty responses were listed concerning anticipated problems/limitations. From these remarks we can conclude that researchers are concerned about obtaining funding, planning and designing experiments for space (primary), and seeing meaningful applications of their research.

Recommended for study in space were 57 subject areas covering many of the life science disciplines including physiology, biomedical/behavioral sciences, biochemistry, pharmacology, immunology, reproduction and development, cell and tissue culture, plant sciences, microbiology, mycology, toxicology, nutrition and advanced life-support systems.

The seminars described here have served to introduce many persons to life sciences research in space and to renew or reinforce the interest of others. Many verbal expressions and several written responses were received, indicating that the scientific user community is definitely interested in life sciences programs for research in space. Although difficult toquantitate, it appears that in most cases researchers and corporate managers are eager to hear about the space program and what it can do for them.
The midwest regional seminar program has formed a basis for information exchange. In order to nurture ideas and ultimately enlist participation in the space program, NASA should maintain this communication. Limited assistance (courses, seminars) would be helpful to researchers in initial experiment planning; information (or sources) should be provided on related experience, experimental equipment, mission profiles, physical parameters and other background needed by the researcher in preparing proposals. When appropriate, additional follow-up meetings should be held to stimulate action on the part of the contact organization.

If presented properly, a continued user development effort would be a definite asset to NASA's life sciences program, serving in the pre-proposal stage to interest and educate researchers in the various aspects of developing experiments for space research.
APPENDIX A

SEMINAR No. 1
"LIFE SCIENCES RESEARCH IN SPACE - THE SHUTTLE ERA"

A 1-day seminar program

At Battelle, Columbus Laboratories
Teleconference Facility
505 King Avenue
Columbus, Ohio 43201

March 9, 1978
9 am - 4 pm

9:00	 Kenneth E. Hughes - - - - - - - - - - - - - - - - - Battelle
      Greeting
      Introduction of Guests

9:15	 Roger L. Merrill - - - - - - - - - - - - - - - - - Battelle
      Battelle - an Emphasis on Space Applications Research

9:30	 Film, "Space Transportation System"

9:50	 John A. Mason - - - - - - - - - - - - - - - - - Johnson Space Center
      Space Shuttle
      History
      Mission Profile
      Spacelab and other Payloads
      NASA Goals

10:20	 Coffee Break

10:40	 Jack R. McDowell - - - - - - - - - - - - - - - - - Battelle
      Shuttle Payload user Charge Policy
      Battelle Project SARP
      Small Self-Contained Research Payloads

11:10	 William K. Douglas - - - - - - - - - - - - - - - - - McDonnell-Douglas
      Man in Space
      Adaptability
      Limitations
      Problems
      Benefits from Space Research
11:40 Questions and Answers - - - - - - - - - - - - - - Panel Response
11:50 Break for Lunch
12:00 Buffet Luncheon - - - - - - - - - - - - - - - - - - Battelle Cafeteria
1:00 Film "Biological Applications in Space"
1:20 Gerald R. Taylor - - - - - - - - - - - - - - Johnson Space Center
   Research topic:
   "Cellular Systems in Space"
1:50 Robert E. Schwerzel - - - - - - - - - - - - - Battelle
   Research topic: "Prospects for Photochemically-Assisted Life Support
   in Space Habitats"
2:20 Paul D. Klimstra - - - - - - - - - - - - - - - - G. D. Searle
   Industrial Sponsorship of Research in Space
   Cost vs. Benefits
   Return on Investment
   Proprietary Rights
2:50 Coffee Break
3:10 John A. Mason - - - - - - - - - - - - - - - - - - Johnson Space Center
   Using the Space Shuttle
   Defining your need for space research
   Interfacing with NASA and the Space Applications Community
   Researching NASA's data files
   Responding to Announcements of Opportunity
3:40 Questions and Answers - - - - - - - - - - - - - - Panel response
4:00 Adjournment
(1) William K. Douglas, M.D.
McDonnell Douglas Astronautics Co.
5301 Bolsa Avenue
Dept. 262, Mail Station 13-3
Huntington Beach, California 92647
(714) 896-3919

(2) Kenneth E. Hughes
Bioengineering/Health Sciences Section
Battelle, Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
(614) 424-7627

(3) Paul D. Klimstra
Vice President, Pre-Clinical Research & Development
G. D. Searle and Co.
Box 5110
Chicago, Illinois 60680
(312) 982-7867

(4) John A. Mason /SD5
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Lyndon B. Johnson Space Center
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(7) Robert E. Schwerzel
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505 King Avenue
Columbus, Ohio 43201
(614) 424-5637

(8) Gerald R. Taylor /SD4
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NASA
Lyndon B. Johnson Space Center
Houston, Texas 77058
(713) 483-4086
### Registration List

<table>
<thead>
<tr>
<th>NAME</th>
<th>AFFILIATION</th>
<th>FIELD OF INTEREST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gordon Black</td>
<td>Division of Mental Health State of Ohio</td>
<td>General</td>
</tr>
<tr>
<td>Deputy Commissioner</td>
<td>1382 State Office Tower 30 E Broad Street</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Columbus OH 43215</td>
<td></td>
</tr>
<tr>
<td>Robert S. Carbonara</td>
<td>Battelle-Columbus Labs 505 King Avenue</td>
<td>Materials/Materials Processing</td>
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<tr>
<td></td>
<td>Columbus OH 43201</td>
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<tr>
<td>David L. Clark</td>
<td>414 B Hamilton Hall Ohio State University</td>
<td>Vestibular System of Equilibrium</td>
</tr>
<tr>
<td>Associate Professor of Anatomy</td>
<td>1645 Neil Avenue</td>
<td></td>
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Now's Chance To Orbit It Aboard New Space Shuttle

By James Breiner
Of The Dispatch Staff

Better book a reservation now on the Space Shuttle for your scientific experiment.

So far, 171 spaces have been reserved at $500 each, and the National Aeronautics and Space Administration (NASA) is still taking orders, according to Jack H. McDowell, associate manager of space experiments and space systems at Battelle Columbus Laboratories.

DURING A seminar at Battelle, 505 King Ave., Thursday, McDowell told some 30 research scientists and corporate officials how they could get their experiments aboard the Shuttle.

A payload weighing 200 pounds and taking up 5 cubic feet of space would cost the experimenter about $10,000, and his payload would have to meet strict specifications set up by NASA. So far 99 spaces have been reserved by industrial concerns, 34% by educational institutions and 37% by private researchers, McDowell told the members of the seminar on "Life Sciences Research in Space -- The Shuttle Era."

McDOWELL CALLS the program for getting small self-contained research packages aboard Shuttle flights the "getaway special."

The experiments would be put aboard the Shuttles -- which are to begin about 20 orbital flights a year in 1980 -- on a space available basis. McDowell calls these experiments "stocking stuffers," since they would fill up space not being used.

The "getaway special" is just one of the ways that NASA is attempting to make space research an independently funded undertaking.

HE SAID it will be possible for a large corporation like RCA or Western Union, which have paid to have communications satellites launched, to save as much as $10 million by having its satellites put into orbit on the Shuttle flights.

The Space Shuttle is a combination aircraft and spaceship, which is launched into space by two booster rockets and can re-enter the atmosphere and land like an airplane.

Thus it can be used again and again, unlike previous space vehicles. Even the booster rockets are recoverable and reusable for the first time.

SELF-CONTAINED experiments could test manufacturing processes, the reaction of organic material to the weightless environment of space, or, for a little extra, NASA could arrange to have the payload exposed to the solar radiation and the cold vacuum of outer space.

Cost to the experimenter will increase as special services for the experiment increase.

Among the those attending the seminar were an aerospace engineer, a mental health official, a representative of a drug manufacturer, and an expert on cardiovascular physiology, indicative of the wide variety of applications that experiments in space could have.

HOWEVER, THE back room inventor should not rush off to NASA and book a place on a Shuttle flight just yet.

NASA will select experiments on the basis of the competence of the investigator, the scientific merit of the test, the reputation of the investigator's institution and other factors.

The man who wants to test his perpetual motion machine in a weightless environment might just find the flights are all booked up.
APPENDIX B

Seminar No. 2
SEMINAR NO. 2

"LIFE SCIENCES
RESEARCH IN SPACE:
THE SHUTTLE ERA"

Battelle, Columbus Laboratories in conjunction with NASA, Johnson
Space Center, is participating in a pilot program to promote the use of
space for research by the life sciences community. This series of
seminars, directed to the interests of researchers and managers from
industry, universities and government agencies, is planned to:

- Describe the space shuttle vehicle and some of its intended uses
- Discuss problems of manned spaceflight
- Stimulate ideas for biological research in space
- Discuss costs and potential for industrial and government
  sponsorship
- Show the researcher or corporate planner how to become part of
  the program for Life Sciences Research in Space.

Attendance at the June 15, 1978 seminar will be limited to 50 persons;
please return the response form or call to confirm your reservation at
the meeting. There is no registration fee.

Battelle, Columbus Laboratories
Teleconference Facility
505 King Avenue
Columbus, Ohio 43221

June 15, 1978
9:00 a.m.-3:30 p.m.
MORNING SESSION

9:00  Kenneth E. Hughes                  Battelle
     Greeting
     Introduction of Guests

9:15  William J. Clarke                 Battelle
     Battelle—An Outlook for Contract Research in Space

9:30  John A. Mason                    Johnson Space Center
     Space Shuttle/SpaceLab
     History
     Mission Profile
     Spacelab and other Payloads
     NASA Goals

10:00 Jack R. McDowell                Battelle
     Autonomous Payloads
     Small Self-Contained Research Payloads
     Materials Experiment Apparatus
     Battelle Project SARP
     Shuttle Payload User Charge Policy

10:30 Break

10:50  Ronald B. Hoffman              General Electric
     Experiments in Space—The Man/Equipment Interface
     Principal Investigator Interactions
     Payload Specialists
     Laboratory Equipment for Use in Space

11:20 Questions and Answers          Panel Response

11:30 Buffet Luncheon               Battelle Cafeteria

AFTERNOON SESSION

12:40 Film “Biological Applications in Space”

1:00 Phillip C. Johnson             Baylor College of Medicine
     Research Topic: “Biomedical Research—Man’s Response to the Space Environment”

1:30 H. William Scheld             University of Houston
     Research Topic: “Plant Physiology Experiments for Spacelab”

2:00 George T. Brooks             NIAMDD
     Programs of the National Institutes of Health:
     Potential for Space Research
     NIH Program Goals
     Benefit to Mankind
     Grant Review Process

2:30 Break

2:50 John A. Mason                  Johnson Space Center
     Using the Space Shuttle
     Defining your need for space research
     Interfacing with NASA and the Space Applications Community
     Researching NASA’s data files
     Responding to Announcements of Opportunity

3:20 Questions and Answers          Panel Response

3:30 Adjournment

*NIAMDD—National Institute of Arthritis, Metabolism, and Digestive Diseases.
LIFE SCIENCES RESEARCH IN SPACE:
THE SHUTTLE ERA

Seminar No. 2

Battelle-Columbus Laboratories
Teleconference Facility
505 King Avenue
Columbus, Ohio

June 15, 1978

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THE SHUTTLE ERA

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<td>Moses W. Vaughn</td>
<td>Division of Prof Studies</td>
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<td>Professor of Food Science</td>
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<td>Sigmund F. Zakrzewski</td>
<td>Department Experimental Therapeutics</td>
<td>Cancer Research</td>
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<td>Principal Cancer Research</td>
<td>Roswell Park Memorial Institute</td>
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<tr>
<td>Scientist</td>
<td>666 Elm Street</td>
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<td>Buffalo NY 14236</td>
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APPENDIX C

SEMINAR FOLLOW-UP SURVEY
1. Please indicate any correction to your address, above

2. May we retain your name on a mailing list for further information/announcements?  Yes ☐ No ☐

3. Do you now receive NASA announcements of opportunity (AO)?  Yes ☐ No ☐

4. May we refer your name to NASA for future mailings of AO's, newsletters, etc.?  Yes ☐ No ☐

5. Are there other persons in your organization who you think would appreciate receiving information on the Space Shuttle program? (Research or Management)

   Name ___________________  Title ___________________
   __________________     __________________
   __________________     __________________

6. Did the Seminar stimulate your interest in research in space?  Yes ☐ No ☐

7. Have you ever worked with NASA  Yes ☐ No ☐


   If YES, please complete No. 9 & 10.
Formal proposals are due by June 30, 1978.

9. Do you intend to submit a proposal to NASA for flight experiments under this AO?  
   Yes □  No □

SUBJECT AREA

10. Will you need assistance in understanding the AO and Proposal Requirements?  
    Yes □  No □

11. What problems/limitations do you envision in carrying out life sciences research in space?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

12. What subject areas would you recommend for study in space? (by yourself or others)

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

13. Would you like to develop an experiment for research in space?  
    Yes □  No □

SUBJECT AREA

14. Need more information on: related experience □
    experimental equipment □
    physical phenomena □
    Other ________________________________

Please return this survey in the enclosed business reply envelope. Thank you.

Kenneth E. Hughes
APPENDIX D

EXERPTS FROM RETURN MAIL
I would like to thank you for giving me the opportunity to attend the seminar regarding life science research on the space shuttle, and also I wish to thank you for your hospitality. The seminar was very useful and stimulating for me and helped clarify a number of points.

I would like some more information concerning your program of Life Sciences Research in the Space Shuttle Era.

I learned of your seminars at the Toledo Univ. Conference.

Please let me know when your upcoming seminars are, and the results of your previous sessions has been.

I regret that I could not participate in the Life Sciences Research in Space - The Shuttle Era conference on June 15.

I will hope to be more responsive in the future.

I am interested in learning more about this area. However, my schedule does not allow for me to be in Columbus on April 20. Please keep me informed of the program and perhaps we can talk either in Columbus or Elkhart.
With the Air Force’s renewed interest in space research we are interested in possible application of human operator technology to your field. If you feel Battelle can enlighten us on possible contributions that would fit naturally within our research mission we would be happy to schedule the meeting with you at mutual convenience.

Thank you very much for including us on the mailing list for your seminars. We hope that our schedule will allow for better participation in the future.

Unfortunately, neither I nor an appropriate colleague can attend your April 20th, 1978 meeting. Please keep us notified of any future seminars.

Special thanks to organizing committee for an excellent Seminar series on "Life Sciences Research in Space - The Shuttle Era", held on June 15, 1978 at Battelle Columbus Labs.