167

OAK RIDGE NATIONAL LABORATORY
operated by
UNION CARBIDE CORPORATION
NUCLEAR DIVISION
for the
U.S. ATOMIC ENERGY COMMISSION

ORNL-TM-2311

LOCKHEED MARTIN ENERGY RESEARCH LIBRARIES
3 4456 0513126 5

CENTRAL RESEARCH LIBRARY
DOCUMENT COLLECTION

BIOLOGY DIVISION

HABROBRACON EXPERIMENT P-1079

QUARTERLY PROGRESS REPORT

TO THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

July 1 - September 30, 1967

OAK RIDGE NATIONAL LABORATORY
CENTRAL RESEARCH LIBRARY
CIRCULATION SECTION
4500N ROOM 175
LIBRARY LOAN COPY
DO NOT TRANSFER TO ANOTHER PERSON.
if you wish someone else to see this report, send in name with report and the library will arrange a loan.
ORNL-118 (6-97)

NOTICE This document contains information of a preliminary nature and was prepared primarily for internal use at the Oak Ridge National Laboratory. It is subject to revision or correction and therefore does not represent a final report.

LEGAL NOTICE

This report was prepared as an account of Government sponsored work. Neither the United States, nor the Commission, nor any person acting on behalf of the Commission:

A. Makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used in the above, "person acting on behalf of the Commission" includes any employee or contractor of the Commission, or employee of such contractor, to the extent that such employee or contractor of the Commission, or employee of such contractor prepares, disseminates, or provides access to, any information pursuant to his employment or contract with the Commission, or his employment with such contractor.

ORNL-TM-2311

BIOLOGY DIVISION

QUARTERLY PROGRESS REPORT
TO THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

July 1 — September 30, 1967

NOVEMBER 1968

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

LOCKHEED MARTIN ENERGY RESEARCH LIBRARIES
3 4456 0513126 5

QUARTERLY PROGRESS REPORT
TO THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Title of Project:

Mutagenic Effectiveness of Known Doses of Gamma Radiation in Combination with Weightlessness on Habrobracon

For the Period:

July 1 – September 30, 1967

Principal Investigator:

R. C. von Borstel

Coinvestigators:

Roger H. Smith

Anna R. Whiting

Robert L. Amy
Department of Biology
Southwestern University
Memphis, Tennessee

Sohei Kondo
Faculty of Medicine
Osaka University
Osaka, Japan

D. S. Grosch (supported by NASA Research Grant No. NsG678)
Department of Genetics
North Carolina State University
Raleigh, North Carolina

Technical Staff:

Katherine T. Cain
Martha S. Jones
Margaret J. Lane
Joan W. Reel
Judith A. Winchester

Consultants:

M. B. Baird
Department of Biology
University of Delaware
Newark, Delaware

Arnold M. Clark
Department of Biology
University of Delaware
Newark, Delaware

Thomas J. Mizianty
Department of Biology
Wilkes College
Wilkes-Barre, Pennsylvania

Mary Lou Pardue
Department of Biology
Yale University
New Haven, Connecticut

Diana B. Smith
Biometrics and Statistics
Oak Ridge National Laboratory
Oak Ridge, Tennessee

L. R. Valcovic
Department of Genetics
North Carolina State University
Raleigh, North Carolina

Name of Institution:

Biology Division
Oak Ridge National Laboratory

Address:

Post Office Box Y
Oak Ridge, Tennessee 37830

Interagency Agreement:

Purchase Order R-104 Task No. 8

Experiment Proposal No.:

P-1079

Support:

Research jointly sponsored by the National Aeronautics and Space Administration and by the U. S. Atomic Energy Commission under contract with the Union Carbide Corporation.

CONTENTS

I. Introduction 1

II. Dosimetry Tests with Toshiba Glass Rods in the Ground-Based Control Set-Up 2

III. The 201 Walk-Through and the 301 Gantry Tests 12

IV. Pre-Flight, Flight, and Post-Flight Activities at Hickam Field and the University of Hawaii 15

V. The Flight of Biosatellite II 19

VI. Goddard Space Flight Center Operations for Biosatellite II 42

VII. Survival of Habrobracon Males and Females in the Biosatellite II Experiment 49

VIII. Post-Flight Mating Behavior of Males in the Biosatellite II Experiment 54

IX. Supplement to Standing Instructions and Flight-Time Instructions for the Habrobracon (P-1079) Experiment in the Three-Day Biosatellite 57

I. INTRODUCTION

Roger H. Smith R. C. von Borstel

This quarterly report is concerned primarily with preparation for the flight of Biosatellite II, the flight itself, and the immediate post-flight activities and results.

The July dosimetry test of the Habrobracon packages in the ground-based control set-up is summarized. This test was designed to make possible preliminary dose-action evaluation of the flight data even before the geometric parameters of the spacecraft itself were studied dosimetrically. The principal benefit from this test was Dr. Hewitt's discovery of a major source of error, the drastic alteration of the source-holder by the subcontractor. In finding this error, Dr. Hewitt performed a great service, since this prevented a recurrence of the mistake during the pre-flight operations necessary for a successful experiment.

A full report of the activities surrounding the flight of Biosatellite II is included. The only post-flight data available for this quarter of 1967 are the survival of the animals and the erratic mating behavior of the Habrobracon males after they were recovered from the flight capsule.

II. DOSIMETRY TESTS WITH TOSHIBA GLASS RODS IN THE GROUND-BASED CONTROL SET-UP

R. C. von Borstel Joan W. Reel Katherine T. Cain

Three dosimetry test of nearly equal duration were conducted at Cape Kennedy on July 17-20, 1967. The source used was ^{85}Sr, and the "optical bench" was the ground-based control set-up for the Biosatellite.

This test was needed to provide a preliminary, experimentally determined estimate of exposure to the chambers in which the Habrobracon are held. At present the exposure can be obtained only from extrapolation of the measurements recorded by Toshiba glass rods directly behind the chambers and from extrapolation from external tubes containing LiF which are behind and in front of the chambers.

Until direct measurements of the Habrobracon chambers are carried out, only qualitative comparisons can be made between the Biosatellite experiment and its ground-based controls.

Methods and Materials

Toshiba glass rods and plastic inserts were placed in the holes in the modules that were made for them (Fig. 1) and the LiF powder was placed in the external tubes especially designed for it. In addition, LiF powder was placed directly in the chamber of each module where the Habrobracon are ordinarily contained (Fig. 2). Screens are always placed on top of each chamber before the cap is screwed on. An LiF radiation detector and a CaF_2 radiation detector provided by E. G. & G. Company were scotch-taped on top of each screen in these dosimetry tests (Fig. 2).

In addition, exposure recorders were placed in the biological dosimeter containers; these containers were placed in the hole in the bracket that was made for them. Two containers, each having two compartments, were placed in each hole.

NASA-AR-1632B-1874

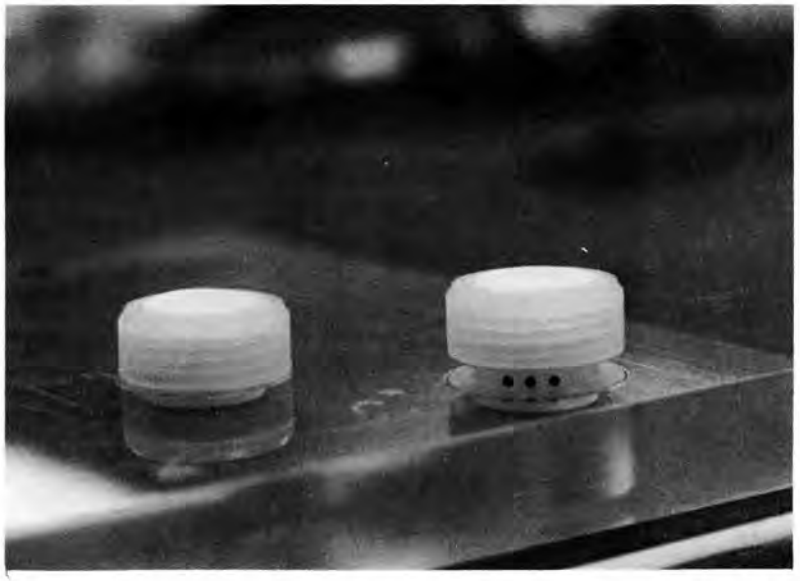


Fig. 1. Modules with the Cap Tightened (on the left) and the Cap Sitting Loosely in Place (on the right). The Three Holes Beneath the Cap on the Module on the Right Have the Glass Rods and Plastic Inserts in Place.

NASA-AR-1632B-1870

Fig. 2. The Space in the Module Where the Habrobracon Are Contained Is Filled with Lithium Fluoride Powder. The Screen To Be Placed Over This Space Has a CaF and an LiF Rod Sitting on It. These Rods Were Attached in Place with Scotch Tape Before Tightening in Place Beneath a Module Cap.

In Test 1, LiF powder and one Toshiba glass rod were placed in each compartment. In Test 2 and Test 3, a glass rod was held snugly in a polyethylene insert which was placed in the innermost compartment of each container. LiF and CaF_2 radiation detectors were wrapped tightly in cotton and placed in the remaining two compartments in each bracket.

Each package was bolted in place on the backscatter shield, and the ^{85}Sr source was activated. The first test, beginning at 8:30 p.m. on July 17, lasted 12 hr; the second, beginning at 7:00 p.m. on July 18, lasted 12 hr 5 min; and the third, beginning at 12:20 p.m. on July 19, lasted 12 hr 10 min. Five minutes were added each day to compensate for the approximate 1% decay of the ^{85}Sr per day.

The same packages and modules were used in Test 1 and Test 3; the packages and modules used in Test 2 were from another series.

After each test, each glass rod was placed in a separate glassine envelope for storage (Fig. 3). In this way they never were misplaced or mixed up.

Results

The glass-rod data for the modules containing the Habrobracon are listed in Table 1. The packages are listed for their nominal exposure position. The modules are listed by their position on the bracket as faced from the source (UL is upper left, LR is lower right, etc.). Each reading is the average of three glass rods, each read once, inverted, and read again, since both ends of a rod yield valid data. Fewer than 5% of the rods were chipped or scratched during the manipulations of loading and unloading, and even from these, one end could usually be read.

The data on exposures to the biological dosimeter location are shown in Table 2. Different conditions were used in Test 1 from those in Test 2 and Test 3. These conditions are listed in the table.

Thirty-three rods were given to Dr. John E. Hewitt to use in packages other than the Habrobracon packages in the gound-based control set-up. The rod numbers are listed (Table 3). Their positions were encoded and not known to us.

NASA-AR-1632B-1867

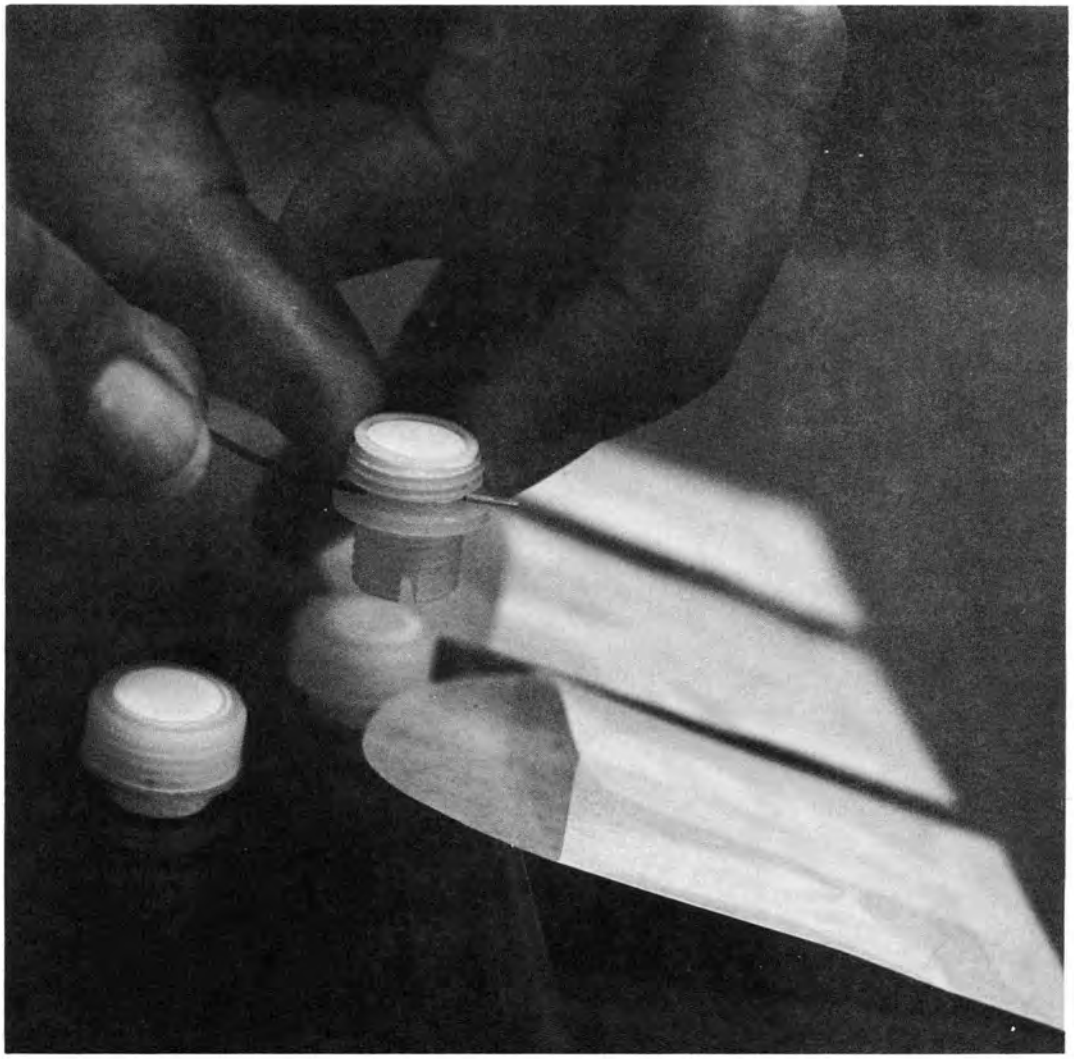


Fig. 3. The Glass Rods Are Pushed into Individual Envelopes. The Three Envelopes Seen in the Figure Are To Hold the Glass Rods from One Module.

Table 1. Dosimetry tests using ^{85}Sr radiation at Cape Kennedy, July 17-20, 1967*

Nominal Exposure (R) Module Position	2F† Average Module	2F Average Horizontal (upper - lower)	2F Average Vertical (right - left)	2F Average Package	Nominal Exposure (R) Module Position	2F† Average Module	2F Average Horizontal (upper - lower)	2F Average Vertical (right - left)	2F Average Package
Test 1 - 4000					4000				
UL	627.4	630.0		602.6	UL	637.1	638.4		607.8
UR	632.7		604.3		UR	639.8		608.5	
LR	575.9	575.2			LR	577.3	577.1		
LL	574.5		600.9		LL	576.9		607.0	
Test 2 - 4000									
UL	650.5	648.2		613.4					
UR	645.9		615.2						
LR	584.5	578.6							
LL	572.8		611.6						
Test 3 - 4000									
UL	633.3	637.0		607.2					
UR	640.8		606.1						
LR	571.5	577.4							
LL	583.3		608.3						
Test 1 - 2000					2000				
UL	321.0	324.6		309.7	UL	327.1	326.8		310.7
UR	328.1		311.7		UR	326.5		310.2	
LR	295.3	294.8			LR	293.9	294.6		
LL	294.3		307.7		LL	295.4		311.2	
Test 2 - 2000									
UL	334.3	331.8		314.1					
UR	329.3		312.1						
LR	295.5	296.4							
LL	297.3		315.8						
Test 3 - 2000									
UL	326.0	324.0		308.4					
UR	322.0		306.5						
LR	291.0	292.8							
LL	294.5		310.3						
Test 1 - 1000					1000				
UL	195.0	194.0		187.6	UL	197.1	197.4		191.3
UR	193.1		187.3		UR	197.7		191.4	
LR	181.4	181.2			LR	185.2	185.2		
LL	180.9		187.9		LL	185.2		191.2	
Test 2 - 1000									
UL	199.6	200.3		193.9					
UR	201.1		193.9						
LR	186.6	187.4							
LL	188.2		193.9						
Test 3 - 1000									
UL	196.8	197.8		192.4					
UR	198.8		193.2						
LR	187.5	187.0							
LL	186.5		191.6						
Test 1 - 500					500				
UL	90.3	91.3		88.3	UL	91.7	92.1		88.7
UR	92.4		88.7		UR	92.6		88.9	
LR	85.0	85.3			LR	85.2	85.3		
LL	85.5		87.9		LL	85.4		88.5	
Test 2 - 500									
UL	92.3	93.1		89.8					
UR	93.8		90.2						
LR	86.6	86.5							
LL	86.4		89.4						
Test 3 - 500									
UL	92.4	91.9		88.0					
UR	91.5		87.7						
LR	83.9	84.1							
LL	84.2		88.3						

*Test 1 - July 17, 12 hr; Test 2 - July 18, 12 hr 5 min; Test 3 - July 19, 12 hr 10 min.

†F is the designation for the fluorescence measurement on the Toshiba reader; in this range of exposures F = R/2, where R is the exposure in roentgens.

Table 2. Dosimetry from biological dosimeter containers*

Nominal Exposure (R)	Test	Container Position	Condition	2F† Average Package	Average per Test	Average per Package
4000	1	Inner	Glass rods put in LiF powder	321.5	344.4	361.3
		Middle-Inner		354.5		
		Middle-Outer		361.0		
		Outer		340.5		
4000	2	Inner	Centered	369.3 LiF, CaF_2 rods	368.6	
		Middle-Inner				
		Middle-Outer		368.0 LiF, CaF_2 rods		
		Outer				
4000	3	Inner	Centered	362.5 LiF, CaF_2 rods	371.0	
		Middle-Inner				
		Middle-Outer		379.5 LiF, CaF_2 rods		
		Outer				
2000	1	Inner	Glass rods put in LiF powder	196.8	207.5	216.6
		Middle-Inner		216.8		
		Middle-Outer		209.0		
		Outer		207.5		
2000	2	Inner	Centered	217.5 LiF, CaF_2 rods	222.3	
		Middle-Inner				
		Middle-Outer		227.0 LiF, CaF_2 rods		
		Outer				
2000	3	Inner	Centered	218.5 LiF, CaF_2 rods	219.9	
		Middle-Inner				
		Middle-Outer		221.3 LiF, CaF_2 rods		
		Outer				
1000	1	Inner	Glass rods put in LiF powder	138.5	143.0	145.9
		Middle-Inner		138.5		
		Middle-Outer		149.0		
		Outer		146.0		
1000	2	Inner	Centered	145.5 LiF, CaF_2 rods	149.8	
		Middle-Inner				
		Middle-Outer		154.0 LiF, CaF_2 rods		
		Outer				
1000	3	Inner	Centered	143.5 LiF, CaF_2 rods	144.8	
		Middle-Inner				
		Middle-Outer		146.0 LiF, CaF_2 rods		
		Outer				
500	1	Inner	Glass rods put in LiF powder	71.0	71.9	72.0
		Middle-Inner		72.5		
		Middle-Outer		73.0		
		Outer		71.0		
500	2	Inner	Centered	68.3 LiF, CaF_2 rods	70.1	
		Middle-Inner				
		Middle-Outer		72.0 LiF, CaF_2 rods		
		Outer				
500		Inner	Cotton around rod	73.5 LiF, CaF_2 rods	74.0	
		Middle-Inner				
		Middle-Outer	Centered	74.5 LiF, CaF_2 rods		
		Outer				

*Test 1 - July 17, 12 hr; Test 2 - July 18, 12 hr 5 min; Test 3 - July 19, 12 hr 10 min.

†F is the designation for the fluorescence measurement on the Toshiba reader; in this range of exposures F = R/2, where R is the exposure in roentgens.

Table 3. Dosimetry of Toshiba glass rods placed in positions other than the Habrobracon packages*

Test	Rod Number	Average
1	H- 1	235.0
	H- 2	226.5
	H- 3	213.5
	H- 4	Rod lost
	H- 5	313.5
	H- 6	273.5
	H- 7	228.5
	H- 8	226.0
	H- 9	210.0
	H-10	232.0
	H-11	202.0
2	H-12	258.0
	H-13	253.0
	H-14	227.5
	H-15	209.5
	H-16	493.0
	H-17	417.0
	H-18	388.8
	H-19	405.3
	H-20	262.0
	H-21	251.5
	H-22	223.0
3	H-23	245.0
	H-24	240.5
	H-25	207.5
	H-26	382.3
	H-27	342.5
	H-28	363.5
	H-29	327.5
	H-30	229.0
	H-31	239.0
	H-32	207.0
	H-33	207.5

*Test 1 - July 17, 12 hr; Test 2 - July 18, 12 hr 5 min; Test 3 - July 19, 12 hr 10 min.

Discussion

Three tests were carried out under supposedly identical conditions in the ground-based control set-up for the Biosatellite. It is clear that the exposures received differ over a range of 7%. Since all rods varied in the same direction from test to test, we believe that the measurements are real and not attributable to intrinsic variation among rods. There are two possible explanations for this test-to-test variability: either (1) there is a drift in the Toshiba reader, or (2) the tests were not identical. The Toshiba glass rods were read in a constant order, with all of the rods from Test 1 being read, then the rods from Test 2. These were read on July 24. On July 25 the rods from Test 3 were read.

The rods from the 4000 R nominal exposure were read again on July 28, with all of the rods from each module position in all three tests being read one after another, instead of in order of the tests. The test-to-test variability remained as it was, indicating there is no appreciable drift in the Toshiba reader. Under this circumstance we can only attribute the test-to-test variability to slight changes in the experimental set-up.

It seems unlikely that there are differences in the two sets of packages that can account for the shift, because all four packages received a larger exposure in the second test, and package-to-package variability under this circumstance should be random. It seems unlikely that side-to-side or backward-forward placement of packages accounts for the difference, because the 500 R nominal exposure package also shows the variability and, of all the Habrobracon packages, it is in the most rigidly aligned position (von Borstel, Daniele, and Park, 1967). Nevertheless, a difference in module placement in the packages is not excluded, because Tests 1 and 3 were more alike and here the same packages were used. Different packages were used in Test 2.

The Habrobracon packages surround the source, and all four exhibited a shift in the same direction from test to test. A better guess for the reason for the difference in the tests can be made after all data from the dosimetry tests are compared.

One puzzling feature in the data was the consistent 10% variation between the upper and lower modules for every package bolted to the backscatter shield. This has been evident in all previous experiments (von Borstel et al., 1967), particularly at the 500 R nominal exposure position, but it has never before been as marked a discrepancy.

The reason for this discrepancy was found after the dosimetry tests by Dr. John E. Hewitt to be that the source geometry was changed drastically by an unspecified alteration of the source holder. This was done without asking permission to do so by the subcontractor in order to bring the source strength up to specifications. Since this negligence alters the entire geometry from that expected in the flight and its ground-based control, then all of these tests must be repeated before actual exposures to the Habrobracon can be estimated with assurance. This discovery casts suspicion on all previous radiation tests in the ground-based control set-up until more dosimetric analyses are made with a proper source holder.

Summary

The data from the Toshiba glass-rod dosimetry provided evidence that exposures in successive tests in the same set-up varied up to a maximum of 7%. This variation is not attributable to the Toshiba glass rods nor to the Toshiba reader.

The data also confirmed that the source holder had been altered in its geometry from previous tests to these tests. Consequently, further dosimetry experiments are mandatory.

Literature Cited

von Borstel, R. C., J. E. Hewitt, Katherine T. Cain, Nanci L. Badger, and Diana B. Smith, 1967, Radiation conditions for the Habrobracon packages in the ground-based controls of the first Biosatellite flight, ORNL-TM-1958, Quarterly Progress Report to NASA covering the period January 1 - March 31, 1967, pp. 10-18.

von Borstel, R. C., M. A. Daniele, and E. R. Park, 1967, Measurement of the positions of the Habrobracon nominal 500-R package in the Biosatellite and in the ground-based control prior to launch, ORNL-TM-1957, Quarterly Progress Report to NASA covering the period October 1 - December 31, 1966, pp. 14-15.

III. THE 201 WALK-THROUGH AND THE 301 GANTRY TESTS

Roger H. Smith

The walk-through and gantry tests were a necessary rehearsal of all events that would transpire during the actual flight.

The 201 walk-through test was begun on August 3, 1967. The 301 gantry test is presented in detail. There was no deviation from the Standing Instructions and Flight-Time Instructions (ORNL-TM-1957).

The 301 Gantry Test

The flight and ground-control packages were received at 0900, August 27, 1967. FTI 2.7.0 was followed for the preparation and assembly of the Habrobracon packages. Glass-rod and biological dosimeters were loaded in the allotted time with no difficulty. Pre-flight preparation of Habrobracon followed FTI 2.6.0. The insertion of Habrobracon into the modules followed FTI 2.7.5 Appendix A.

These operations were completed at T -573 (573 min before launch, 0447, August 27, 1967). We were supposed to have our operations completed by T -610 (0410); therefore, we were 37 min late. Most of this time was expended in trying to correct a mistake in the coding of the flight packages. The G4 package was labeled with the G3 code (A822), and the G3 package with a G4 code (A810). It was necessary to call this to the attention of the inspector (Mr. N. Beeson) and to contact Mr. H. Asch to correct the error. The numbers were checked with the positions occupied by these packages within the vehicle. When it was determined that the packages had been coded incorrectly by personnel of the General Electric Corporation, the labels were placed on the correct packages (A810 on G4 and A822 on G3). This interruption accounted for approximately 25 of the 37 min. The

other 12-min delay was due to difficulties encountered by new personnel in adjusting to the loading procedures. Therefore, with this rehearsal, we believed that we would be able to complete assembly of the packages in the allotted time for the actual flight of Biosatellite B.

The packages were turned over to Mr. H. Asch to be installed into the vehicle.

After completion of the assembly of packages, at least one person from the Habrobracon experiment was present at Hangar S until simulated splashdown. During this time, necessary laboratory work was performed, such as the washing of Stender dishes, stacking of trays of clean dishes, and the collecting of virgin female Habrobracon (as per FTI) for the flight of Biosatellite B.

Package Disassembly

The flight packages were returned on the afternoon of August 28. They were disassembled according to FTI 4.1.0. The Habrobracon and glass-rod dosimeters were discarded. The module components were thoroughly cleaned according to FTI 1.4.4.0, except that 15 gallons of distilled water were used instead of 5 gallons. This was an added assurance that the modules would be clean for the actual launch.

The ground-control packages were returned to the experimenters on the afternoon of August 31. They were disassembled according to the FTI 4.1.0. The Habrobracon were discarded. The glass-rod dosimeters were placed in labeled glassine envelopes. These dosimeters are used to check the radiation doses received by each module in the ground-based control set-up, which can be compared to the dose levels received during the actual ground-control experiment. The same washing procedures were followed for cleansing these module components as for the flight. All hardware was turned over to Mr. H. Asch for bonded storage.

Literature Cited

Standing Instructions and Flight-Time Instructions for the Habrobracon (P-1079) Experiment in the Three-Day Biosatellite, ORNL-TM-1957, Quarterly Progress Report to NASA covering the period October 1 - December 31, 1966, pp. 29-248.

Supplement to Standing Instructions and Flight-Time Instructions for the Habrobracon (P-1079) Experiment in the Three-Day Biosatellite, ORNL-TM-2311, Quarterly Progress Report to NASA covering the period of July 1 - September 30, 1967, pp. 57-87 (Section IX, this report).

IV. PRE-FLIGHT, FLIGHT, AND POST-FLIGHT ACTIVITIES AT HICKAM FIELD AND THE UNIVERSITY OF HAWAII

R. C. von Borstel Joan W. Reel

R. C. von Borstel was in Hawaii from August 17 to 27; Joan W. Reel arrived on August 27 and stayed through the experiment, departing on September 12 after all post-flight operations had been performed.

Contacts were made on August 17, 1967, with Major L. Drum at Hickam Field and with Dr. Mahesh Upadhya in the Department of Horticulture at the University of Hawaii. Major Drum made available the key to the Biosatellite trailers, and Dr. Upadhya helped obtain short-term laboratory space for us at the Department of Horticulture, since a room with an adequately controlled temperature was not available at Hickam Field. Availability of space at the Department of Horticulture had been offered 2 years previously by Professor James Brewbaker when he learned of our experiment.

The next 10 days were occupied with the organization of laboratories at Hickam Field and the University of Hawaii. The thermoregulator and relays were adjusted by Mr. B. Bartko, Instrument Lab, 1118 Auahi Street, Honolulu.

The Standing Instructions and Flight-Time Instructions were followed throughout. There were but three deviations (from FTI 2.1.3.0, Equipment for Hickam Field): (1) removers for biological dosimeters were brought from Cape Kennedy; (2) Ephestia were not reared at Hickam Field, so corn meal was not taken there; and (3) an insulated bottle was brought from Oak Ridge to carry yeast.

The constant-temperature room at the University of Hawaii was put into continual operation on August 28. The temperature and humidity record during the pre-flight adjustment period are shown in Fig. 4. Internal organization of each laboratory was accomplished during the pre-flight and flight periods.

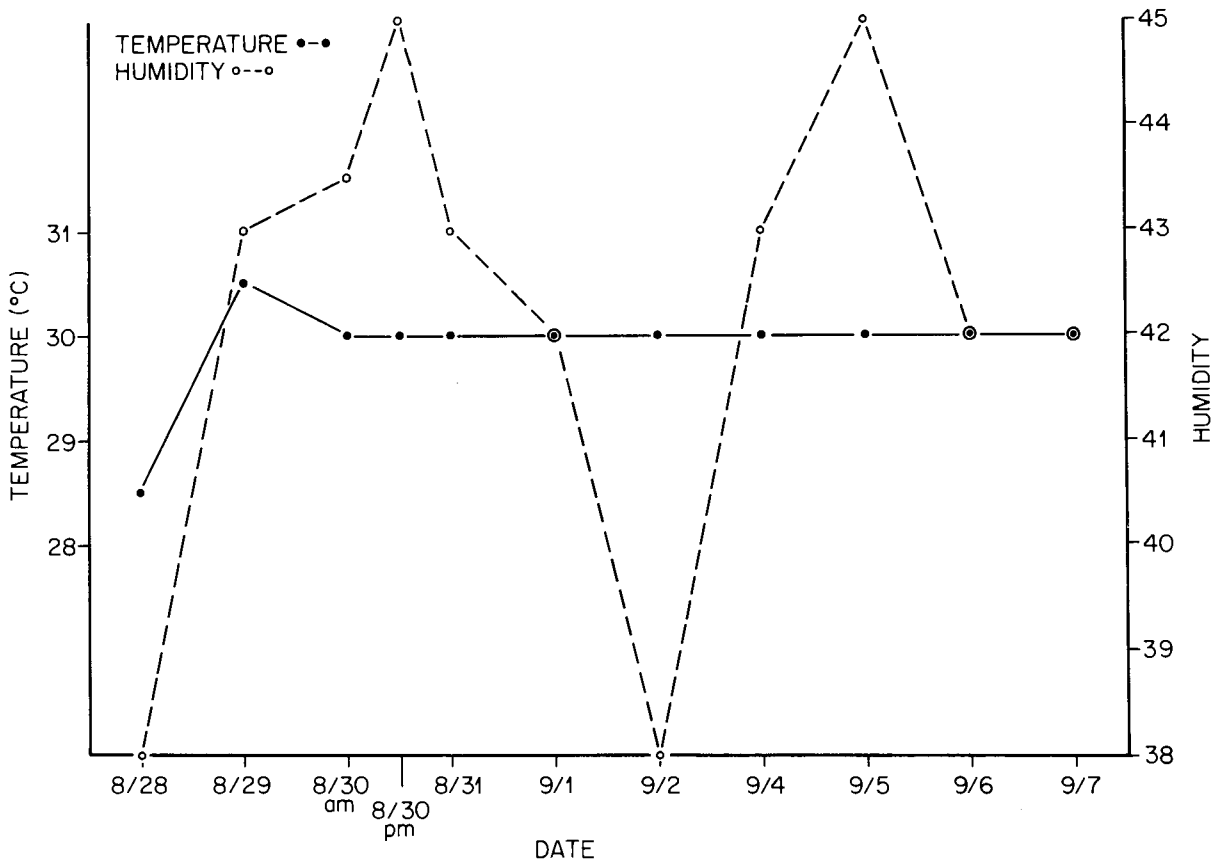


Fig. 4. Temperature and Humidity Record of Constant Temperature Room at the University of Hawaii.

The spacecraft was recovered on September 9. The diary of Joan Reel is recorded here in full from September 8 through the post-flight period.

September 8, 1967 — Everything was in order at Hickam Field and the University of Hawaii. Mary Lou and Judy arrived with caterpillars, females to sting caterpillars and other necessary equipment.

September 9, 1967 — The rest of the equipment was brought to the University of Hawaii, and the CO_2 tank was set up. Approximately 2000 caterpillars were picked. Females were set to sting caterpillars, and these caterpillars were cleaned as they were stung. Female virgins with many sisters were separated to mate half with the 2000 R and 4000 R and the other half with controls. Approximately 2:20 p.m.

the first package was received. Mary Lou and Joan immediately began work unloading the animals (Fig. 5). The animals were counted, and the 100% survival was recorded. The yeast was removed and coded. The dosimeters were removed and put into glassine envelopes. At 5:15 p.m. the first transfer of females was set with stung cats at the University of Hawaii by Mary Lou, Martha, and Joan. After this it was decided that the trailer was too cold to do matings, so all of the necessary equipment was moved to the University of Hawaii, and the matings were begun by Larry, Mary Lou, and Martha. The second transfer was made at 9:15 p.m. by Judy and Joan, and the third at 11:15 p.m. We began to count eggs from the first transfer.

AR-1632B-2185

Fig. 5. Unloading of Flight Packages (Mary Lou Pardue and Joan W. Reel).

September 10, 1967 — The fourth transfer was made at 1:15 a.m. and the fifth at 3:15 a.m. Matings and egg counts were discontinued at 4:00 a.m. Matings and egg counts began again at 12:00 noon. The sixth transfer was at 3:15 p.m. Eight trays were set with caterpillars. The other six trays were transferred to vials. Larry, Mary Lou, and Martha discontinued the matings at this time. The egg counts continued until 6:15 p.m. and began again at 9:30 p.m. The eight trays of transfer six were transferred to vials at 11:15 p.m. Mary Lou and Martha left for Oak Ridge at 11:59 p.m., taking with them the flight males and the females to which they had been mated.

September 11, 1967 — Egg counts were discontinued at 3:00 a.m. and began again at 7:30 a.m. Hatchability was begun and transfer one, two, three, and four were completed at 4:00 p.m. Dr. Grosch arrived on the 11th and began his work. Larry left for Oak Ridge at 11:59 p.m. that evening after packing everything from the trailer.

September 12, 1967 — Hatchability was begun on transfer five at 7:45 a.m., and transfer six was finished at 10:30 a.m. The microscopes were packed and the laboratory was picked up. Judy and Joan left at 11:59 p.m. that evening.

V. THE FLIGHT OF BIOSATELLITE II

Roger H. Smith
R. C. von Borstel
D. S. Grosch
Anna R. Whiting
R. L. Amy
A. M. Clark
T. J. Mizianty
L. R. Valcovic
M. B. Baird
Mary Lou Pardue
Katherine T. Cain
Joan W. Reel
Martha S. Jones
Margaret J. Lane
Judy A. Winchester
Ruth Ann Carpenter
A. C. Hoffman

Biosatellite B was scheduled for launch at 1500 and was launched at 1804 EDT on September 7, 1967. The spacecraft was successfully recovered by an "air-catch" at approximately 1508 EDT on September 9 after 30 orbits instead of after 46 orbits as originally planned. All phases of the Habrobracon experiment proceeded smoothly and followed precisely the schedule as documented in the Flight Time Instructions (ORNL-TM-1957).

The Loading of the Modules

Essentially the same schedule was followed for this launch as was followed in the launch of Biosatellite A (von Borstel *et al.*, 1967). Habrobracon males (*le*) eclosed within 24 hr of the time of loading. Approximately 1200 females had eclosed within 3 to 5 days prior to launch and their pedigrees were established. These females were mated to the *le* males from flight and ground controls. The only major change was the use of females heterozygous for three linked loci [lemon (*le*) and honey (*ho*) body color, and cantaloupe (*c*) eye color] in the flight vehicle and ground-based controls. The progeny of these females were analyzed for spaceflight effects on recombination frequencies. The Habrobracon to be given an acute exposure before being placed in the packages were handed over to Dr. J. E. Hewitt at 0220 EDT, September 7. These were irradiated with an exposure of 2000 R (120.4 R/min for 16.6 min). The source was a portable Norelco operated at 180 kvp

and 4.8 mA. Aluminum filtration (92/1000 inch) was used. The numbers of Habrobracon males and females loaded into the modules are shown in Table 4. The flight spares were used as additional controls in Control III when they were no longer needed as back-up packages.

The time for each event of the loading procedures can be seen in the checklists (Appendix A). The loading events are shown in Figs. 6-10.

Table 4. Numbers of Habrobracon males and females loaded in flight and ground-based control packages for Biosatellite B

	Control Area		Radiation Area		Subtotals	
	♂	♀	♂	♀	♂	♀
Flight	120	120	158	160	278	280
Flight spares	121	120	80	80	201	200
Control I	120	120	159	159	279	279
Control II	119	120			119	120
Control III	118	119			118	119
Totals					995	998

Temperature Data

The orbital thermistor readings in the forward section of the flight vehicle compare closely to the readings in the forward section of the ground-based control set-up (Table 5). There is a 3°C difference between the aft sections of the flight vehicle and the ground-based control set-up. This same trend had been observed for the Biosatellite A experiment.

Table 5. Biosatellite B orbital temperatures for the Habrobracon experiment

Date	Time (EDT)	Orbit	Flight Temperature					Control I Temperature					Control II Temperature	Control III	
			0	500	1000	2000	4000	0	500	1000	2000	4000		Aft	Forward
9/7/67	0600	Pre-launch	70	72	72	72	72	72	71	71	72	71	70	70	70
	0700	Pre-launch						72	71	71	71	71	70	70	68
	0800	Pre-launch	67	70	71	71	71	71	71	71	71	71	70	70.5	68
	0900	Pre-launch						71	71	71	71	71	69	68	68
	1000							72	71	71	72	71	70	70	73
	1100							72	71	71	71	71	70	69	74
	1200							71	71	71	71	71	69	69	72
	1300							71	71	71	71	71	69	69	72
	1400							71	74	74	74	73	69	69	71
	1500							71	75	75	75	75	69	69	72
	1600							71	73	73	73	73	69	69	72
	1700							70	71	71	71	71	69	68	72
	1804	Launch						70	70	70	70	70	69	67	70
	1944	1	70	69	70	71	70	70	69	69	69	69	69	68	68
	2110	2	69	67	69	70	69	69	68	68	69	68	69	68	68
	2259	3	68	68	69	69	68	69	68	68	68	68	70	68	69
9/8/67	0039	4	68	66	69	69	68	69	67	67	67	67	69	67	67
	0213	5	68	66	68	69	68	69	68	67	68	67	70	67	67
	0349	6	67	66	68	68	68	70	68	68	69	68	70	69	67
	0526	7	67	66	68	68	68	70	69	68	69	69	70	67	67
	0706	8	67	66	68	68	68	70	69	69	69	69	70	67	67
	0839	9	67	66	68	69	68	70	69	69	69	69	70	67	67
		10	67	66	68	69	68						70	66	67
	1015	11	67	66	69	68	68	70	69	69	69	69	70	66	67
	1153	12	67	67	68	69	68	70	69	69	69	69	69	66	67
	1229	13	67	67	69	69	68	70	69	69	69	69	71	66	67
	1506	14	67	66	69	69	68	70	69	69	69	69	69	65	67
	1640	15	67	67	68	69	68	70	69	69	69	69	69	69	67
	1816	16	67	67	68	69	68	70	69	69	69	69	69	69	67
	1957	17	67	67	68	69	68	70	69	69	69	69	69	67	67
	2130	18	67	67	69	69	68	70	69	69	69	69	70	67	69
	2315	19	67	67	69	69	68	70	69	69	69	69	70	67	66
9/9/67	0052	20	67	67	69	69	69	71	69	69	69	69	70	67	68
	0229	21	67	67	69	69	69	70	69	69	69	69	70	67	67
	0400	22	68	67	69	69	69	70	69	69	69	69	70	68	67
	0536	23	–	–	–	–	–	70	69	69	69	69	70	68	67
	0713	24	67	67	69	69	69	70	69	69	69	69	70	68	67
	0850	25	67	67	69	69	69	70	69	69	69	69	70	69	68
	0946	26	67	67	69	70	69								
	1027	27	67	67	69	70	69	69	69	69	69	69	70	68	69
	1203	28						69	69	69	69	69	69	68	68
	1346	29						71	69	69	69	69	69	68	69
	1440	Retrofire						70	69	69	69	69	69	68	69
	1513							71	69	69	69	69	70	70	73
	1540							70	69	69	69	69	70	64	64
	1640							70	69	69	69	69	69	64	64
	1740							70	69	69	69	69	70	64	66
	1840							70	69	69	69	69	69	65	67

Fig. 6. Selection of the Habrobracon That Were To Be Used on the Flight (A. M. Clark).

Fig. 7. Transfer of Habrobracon to Modules (Judy A. Winchester and M. B. Baird).

Fig. 8. Attachment of a Module to a Bracket (Mary Lou Pardue).

Fig. 9. Torque-Wrenching of Modules (Ruth Ann Carpenter).

AR-1632B-2131

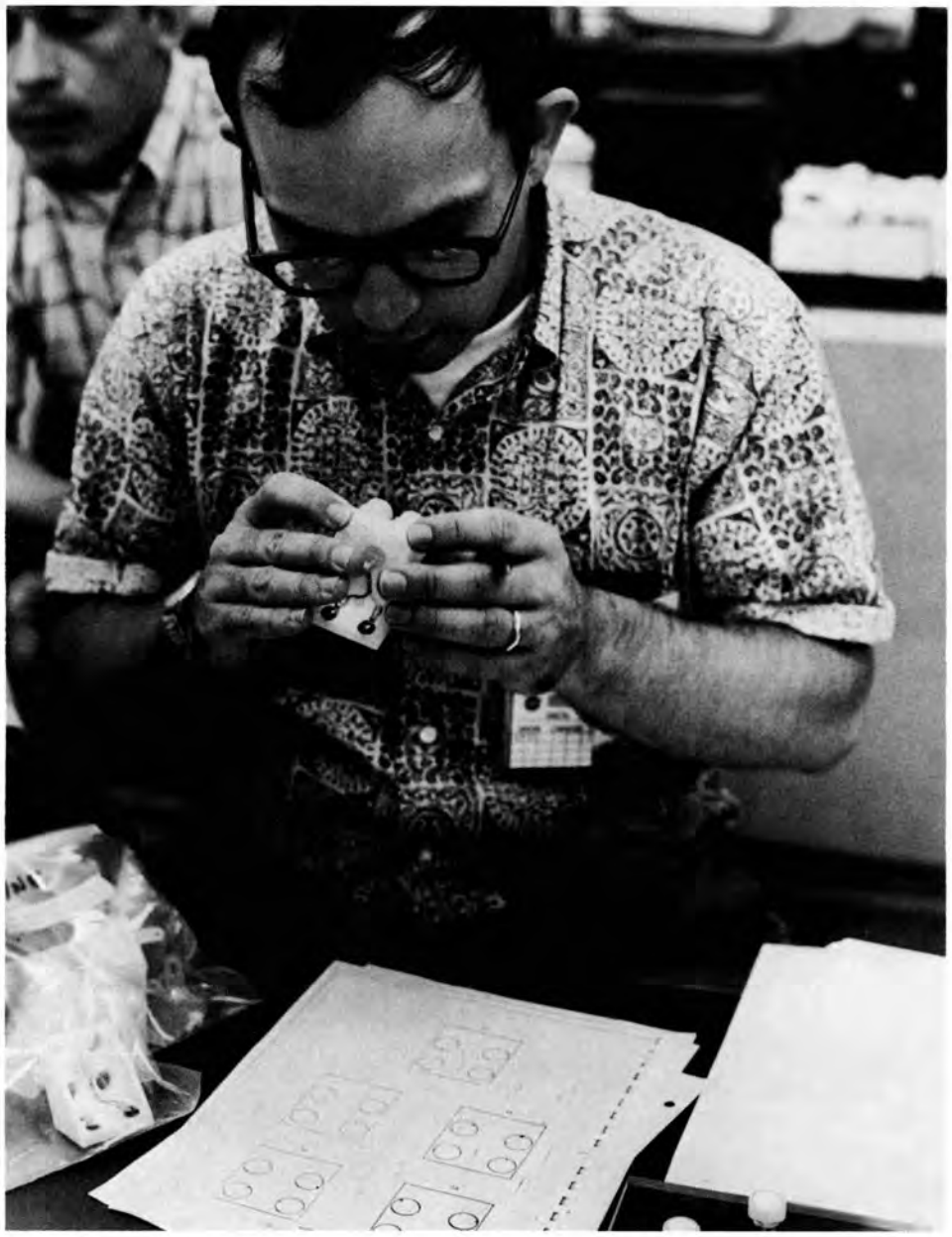


Fig. 10. Inspection of Package and Recording of Position of Modules in the Brackets (R. H. Smith).

In-Flight Activities with the Habrobracon and Ephestia

Paralyzed Ephestia larvae were collected during all of the shifts except the 0400-0800 EDT shift. These were collected as directed in the Flight-Time Instructions so that they would be ready for immediate use during the period of post-flight activities.

Hatchabilities were taken and times of death of embryos were scored on one group of females which had been X-irradiated prior to flight. This irradiation was done at the same time that the males and females were irradiated before they were loaded into the control packages.

Re-entry of Biosatellite II

The flight vehicle was called down on the 30th orbit instead of the 46th because of the prediction of bad weather in the area for programmed recovery. The radiation sources were closed in the spacecraft at 1257 EDT and in the Control I at 1258 EDT. The recovery operations took place as planned; the flight capsule was taken to Hickam Field, Hawaii, for disassembly. The Habrobracon packages from the flight vehicle were turned over to the investigators at Hickam Field at the same time that the ground-control packages were turned over at Cape Kennedy. The post-flight operations were initiated at this time (0820 EDT, September 9, 1967) by both groups.

Flight-time instructions were followed by the groups at Cape Kennedy and Hickam Field. No unexpected events arose during the post-flight operations at Cape Kennedy. Considerable difficulty with male mating behavior was experienced at Hickam Field. The post-flight events are recorded in full for Hickam Field activities (von Borstel and Reel, 1968), and the comparison of males is given in another report (Valcovic *et al.*, 1968).

Literature Cited

Valcovic, L. R., Mary Lou Pardue, Martha S. Jones, R. C. von Borstel, A. M. Clark, M. B. Baird, Ruth Ann Carpenter, and Roger H. Smith, 1968, Post-flight mating behavior of males in the Biosatellite II experiment, ORNL-TM-2311, Quarterly Progress Report to NASA covering the period July 1 - September 30, 1967, pp. 54-56 (Section VIII, this report).

von Borstel, R. C., and Joan W. Reel, 1968, Pre-flight, flight, and post-flight activities at Hickam Field and the University of Hawaii, ORNL-TM-2311, Quarterly Progress Report to NASA covering the period July 1 - September 30, 1967, pp. 15-18 (Section IV, this report).

von Borstel, R. C., Roger H. Smith, Anna R. Whiting, R. L. Amy, D. S. Grosch, L. R. Valcovic, M. B. Baird, Katherine T. Cain, Joan W. Reel, Martha S. Jones, and Margaret L. Haye, 1967, The flight of Biosatellite A, ORNL-TM-1957, Quarterly Progress Report to NASA covering the period October 1 - December 31, 1966, pp. 22-24.

APPENDIX TO SECTION V

Checklists for Loading Procedures Followed in Preparation for the Launch of Biosatellite B

CHECKLIST: FLIGHT ♀

Loading Habrobracon into Modules

Torque : 24 ± 2% in. oz. lbs.

Date: 7 Sept 67

Programmed time: Start T - 700
Finish T - 640

Actual Time: Start 0317
Finish 0349

Modules : UR, LL	Time	Initials
1 UR	0321	
LL		
2 UR	0323	
LL		
3 UR	0325	
LL		
4 UR	0328	
LL		
C UR	0336	
LL		
Sp1 UR	0341	
LL		
Sp2 UR	0338	
LL		
SpC UR	0349	RHS
LL		

PERSON LOADING: ~~M. B. Baird~~
M. L. Perdue

Biosatellite Flight B

CHECKLIST: FLIGHT ♂

Loading Habrobracon into Modules

Torque : 24 ± 2% in. ~~lbs.~~ oz.

Date: 7 Sept 67

Programmed time: Start T - 700
Finish T - 640

Actual time : Start 0317
Finish 0348

Modules: UL, LR		Time	Initials
1	UL	0321	
	LR		
2	UL	0324	
	LR		
3	UL	0326	
	LR		
4	UL	0329	
	LR		
C	UL	0337	
	LR		
Sp1	UL	0342	
	LR		
Sp2	UL	0339	
	LR		
SpC	UL	0348	RHP
	LR		

PERSON LOADING: ~~J. A. Winchester~~
R. A. Carpenter

CHECKLIST: FLIGHT

Placing Modules into Brackets

Torque : 32 ± 2% in. ~~lbs.~~ oz.

Date: [illegible]

0402

Programmed time: Start T - 640
Finish T - 625

Actual time : Start
Finish

Package	Time	Initials
1	0402 0405	
2	0409	
3	0410	
4	0412	
C	0414	
Sp1	0417	
Sp2	0420	
SpC	0422	RHS

CHECKLIST: FLIGHT

Attachment of Radiation Shields

Torque : 24 ± 2% in. lbs.

Date:

Programmed time: Start T - 625
Finish T - 610

Actual time: Start 0406
Finish 0425

Package	Time	Initials
1	0406	
2		
3		
4		
C	******	*******
Sp1		
Sp2	0425	GR
SpC	******	*******

Biosatellite Flight B

CHECKLIST: CONTROL III ♂

Loading Habrobracon into Modules

Torque: 24 ± 2 in. ~~lbs~~ oz.

Date: [illegible]

Programmed time: Start T - 700
Finish T - 640

Actual time: Start 0351
Finish

Modules: UL, LR	Time	Initials
1 [illegible]		
[illegible]		
2 [illegible]		
[illegible]		
3 [illegible]	0357	RNS
[illegible]		

Person [illegible]

CHECKLIST: CONTROL III ♀

Loading Habrobracon into Modules

Torque : 24 ± 2% in. ~~lbs~~ oz.

Date: 7 Sept 67

Programmed time: Start T - 700 Actual time: Start 0357
Finish T - 640 Finish 0357

Modules: UR, LL	Time	Initials
1		
2		
3	0357	GRS

CHECKLIST: CONTROL III

Placing Modules into Brackets

Torque : 32 ± 2% in. lbs.

Date:

Programmed time: Start T - 640
Finish T - 625

Actual time: Start
Finish

Package	Time	Initials
1		
2		
3	0432	

CHECKLIST: CONTROL I ♀

Loading Habrobracon into Modules

Torque : 24 ± 2% in. ~~lbs~~ oz.

Date:

Programmed time: Start T - 700
Finish T - 640

Actual time : Start 0320
Finish 0337

Modules: UR, LL	Time	Initials
1 UR	0323	KTC
LL		
2 UR	0328	KTC
LL		
3 UR	0337	KTC
LL		
4 UR	0326	KTC
LL		
C UR	0338	KTC
LL		

PERSON LOADING: M. R. Baird

Biosatellite Flight B

CHECKLIST: CONTROL I ♂

Loading Habrobracon into Modules

Torque : 24 ± 2~~%~~ in. ~~lbs.~~ oz.

Date: 7 [illegible]

Programmed time: Start T - 700
Finish T - 640

Actual time: Start ~~0317~~ 0320
Finish 0338

Modules: UL, LR	Time	Initials
1 UL	0324	KTC
LR		
2 UL	0329	KTC
LR		
3 UL	0338	KTC
LR		
4 UL	0327	KTC
LR		
C UL	0336	KTC
LR		

PERSON LOADING: J A. Winchester

CHECKLIST: CONTROL I

Placing Modules into Brackets

Torque : 32 ± 2 in. ~~lbs.~~ oz

Date: [illegible]

Programmed time: Start T - 640
Finish T - 625

Actual time : Start 0350
Finish 0406

Package	Time	Initials
1	0350	KTC
2	0352	KTC
3	0401	KTC
4	0404	KTC
C	0406	KTC

CHECKLIST: CONTROL I

Attachment of Radiation Shields

Torque : 24 ± 2% in. ~~lbs.~~ oz.

Date: [illegible]

Programmed time: Start T - 625
Finish T - 610

Actual time: Start 0350
Finish 0406

Package	Time	Initials
1	0353	KTC
2	0357	KTC
3	0403	KTC
4	0406	KTC
C	******	******

CHECKLIST: CONTROL II ♀

Loading Habrobracon into Modules

Torque : 24 ± 2~~%~~ in. ~~lbs~~ oz.

Date: [illegible]

Programmed time: Start T - 700 Finish T - 640

Actual time: Start 0340 Finish 0349

Modules: UR, LL	Time	Initials
		RTC
1 UR		
LL		
2 UR		
LL		
3 UR		
LL		

PERSON LOADING: M. B. Baird

CHECKLIST: CONTROL II ♂

Loading Habrobracon into Modules

Torque : 24 ± 2 in. oz.

Date:

Programmed time: Start T - 700
Finish T - 640

Actual time: Start 0340
Finish 0341

Modules: UL, LR	Time	Initials
1 UL		
LR		
2 UL		
LR		
3 UL		
LR		

PERSON LOADING: J. A. Winchester

CHECKLIST: CONTROL II

Placing Modules into Brackets

Torque : 32 ± 2 in. oz.

Date:

Programmed time: Start T - 640
Finish T - 625

Actual time: Start 0401
Finish 0413

Package	Time	Initials
1 35	0409	KTC
2 40	0411	KTC
3	0413	KTC

VI. GODDARD SPACE FLIGHT CENTER OPERATIONS FOR BIOSATELLITE II

Robert L. Amy

On 6 September, approximately 24 hr before the scheduled launch of Biosatellite B, direct-line telephone communications were established between POCC (Project Operations Control Center) at GSFC, the laboratory control center at Cape Kennedy, and the recovery laboratory at Hickam Field. These links were exercised on a regular basis throughout the remainder of the mission. From 0815 hr on 7 September (launch occurred at 1804 EDT) until the termination of the operation on 9 September, at least two of the three biologists involved (R. Hoffman, E. Keller, and myself) were on duty manning the assigned control center consoles.

Our main duties involved the acquisition, evaluation, and reporting of orbital telemetry data from the spacecraft. Data on each orbit were received by one of the STADAN stations, then relayed to the POCC and made available to us as computer print-outs (see Figs. 11 and 12, copies of actual print-outs for orbit 13). We recorded immediately on the Check List ("Value" column, Fig. 13) certain data from the print-out (Fig. 11, A1-A115) adjudged most relevant to the biological aspects of the flight; thermister temperature readings (Fig. 12) were recorded on the Orbital Temperature form in the "Flight" column of Fig. 14 and individual plots were made for each thermister. (Fig. 15 is an example of such a plot.) Flight-capsule average temperatures (lower left hand corner of Fig. 14) were obtained by averaging selected thermister readings from the forward (FWD) and aft recovery-capsule sections. If any of the parameters fell outside the specified ranges, their interpretation was discussed with appropriate sub-system specialists or control room personnel. The data were transmitted then by voice to laboratory control at Cape Kennedy and to the Hickam Field laboratory. At the same time, temperatures for all control groups being maintained at Cape Kennedy were received and recorded in the proper columns on the Orbital

Temperature form (Fig. 14). Relative humidity values for controls 1 and 2 were received and recorded under the proper columns at this time also (see Fig. 14).

We were concerned also with checking the telemetry data to ascertain whether or not certain commands, of special significance to the biological experiments, had been received and executed by the spacecraft control systems (Fig. 12, right-hand column). According to information received at POCC, the radiation source apparently opened on schedule (T +59 min) during the first orbit and closed at 1257 EDT on 9 September (Fig. 12, A150 is the print-out position at which such information was listed), the tape recorder (A148) and camera (A155) functioned satisfactorily, and all fixing and feeding operations (A200-A213) occurred according to plan.

Recovery operations were monitored from re-entry vehicle-adapter separation at 1440 EDT until the last of the quick-look reports from the experimenters had been received from Hickam recovery laboratory, at approximately 2100 EDT.

Figure 1. Spacecraft telemetry data print-out. (Biosatellite B, orbit 13)

```
                                   BIOSATELLITE B     REAL TIME      VEHICE  301          SYS 670901

FRAME  098                GMT  251  17  29  51                ORBIT NO. 13F!        STATION      FT. MYERS

 ATTITUDE CONTROL SUBSYSTEM                    LIFE SUPPORT SUBSYSTEM                    ELECTRICAL POWER SUBSYSTEM

A1  R RATE   PRIMARY 34 -.107 DES        A50   REC CAP TEMP      26  64.5 DEF.0          +28 VDC REG AD.  35  27.8 VDC
A2  P RATE   PRIMARY 33  .129 DES.       A51   REC CAP REL HUM   38  59.7 PCT           -28 VDC REG AD.  39 -28.0 VDC
A3  Y RATE   PRIMARY 34 -.100 DES        A52   REC CAP T PRESS   47  14.5 PSA           +10 VDC REG AD   45  9.92 VDC
                                         A53   REC CAP PART CO.  19  146. MMH            -10 VDC REG AD   24 -9.98 VDC
    R RATE   SECOND  32  .000 DES.                                                         +5 VDC REG AD   55  4.95 VDC
    P RATE   SECOND  32  .046 DES.                                                         +6 VDC REG AD   54  5.95 VDC
    Y RATE   SECOND  32  .019 DES.       A55   BLOWER  CURRENT   35  .116 AMP             -6 VDC REG AD.  41 -6.03 VDC
                                         A56   RES AIR TK PRESS  58  3481 PSG
    C ROLL   IR SENS 37  4.56 DEG                                                          ORBTL BUSS FINE  31  27.3 VDC
    C PITCH  IR SENS 37 -4.21 DEG                                                           26 VAC REG AD   49  26.0 VAC
    F PITCH  IR SENS 02 -5.27 DEG                                                   A109   OR BATT VOLTAGE  50  27.1 VDC
    F ROLL   IR SENS 02  4.93 DEG              TANKAGE SUBSYSTEM                    A110   OR BATT CURRENT  30  4.29 AMP
    MAGNET   OUTPUT  21  9.26 MLG                                                           SIGNAL GROUND   00  .000 VDC
                                               N2 TANK TEMP      28  54.4 DEF
    R EARTH  PRESNCE 01  0                A71  N2 TANK PRESS     49  2280 PSI             +10 VDC REG CAP  29  9.89 VDC
    P EARTH  PRESNCE 01  0                                                                  -5 VDC REG CAP  32 -5.02 VDC
    YAW SIG  SWITCH      0                                                          A115    +5 VDC REG CAP  50  4.88 VDC
                                               ENVIRON. CONTROL SUBSYSTEM                   115 VAC REG CAP  33  110. VAC LO
    TEMP R   IR SENS 28  56.7 DEF.                                                          4.25VDC REG CAP  54  4.21 VDC
    TEMP P   IR SENS 25  48.3 DEF.             OR BATT TEMP      33  82.3 DEF             -2.5VDC REG CAP  34 -2.68 VDC
                                               OR HEAT TEMP 1    26  64.0 DEF
    PRI-SEC  GYRO    30  P                     OR HEAT TEMP 2    22  59.7 DEF
    JET CON  PWR ON      1                     OR HEAT TEMP 3    27  66.2 DEF              DEORBIT SUBSYSTEM
    MAGNET   SOOM DE.    1                     OR HEAT TEMP 4    25  64.7 DEF
                                                                                           O W S P MONITOR  .000000  SEC
    POS R.   SOLNOID     0                     ADAPTER TEMP 1    32  69.5 DEF                   0000000000000000
    NEG R    SOLNOID     0                     ADAPTER TEMP 2    23  45.3 DEF             MAGNET  PROGRAM 00000000
    POS P    SOLNOID     0                     ADAPTER TEMP 3    25  52.9 DEF
    NEG P    SOLNOID     0                     ADAPTER TEMP 4    43  98.3 DEF             SEPARATE SENSOR  47  1
    POS Y    SOLNOID     0                                                                 ACC-REJ COMMAND  01  0
    NEG Y    SOLNOID     0                A89  CAP Z1  TEMP      29  47.3 DEF             O W S P ERROR        0
                                         A90  CAP Z2  TEMP      31  79.0 DEF             VER ARM COMMAND      0
    N2 REG   PRESS   35  38.2 PSG              AFT COV TEMP RV   31  60.3 DEF
                                                                                           PROGRAM TIMER        19 25
    COARSE MAG A     00 -600. MLG                                                          TIMER CH 1       27
    COARSE MAG B     00 -600. MLG                RECOVERY SUBSYSTEM                        TIMER CH 2       42
                                                                                           TIMER CH 3       32
                                               BAROSW  MONITOR   38  1                     TIMER CH 4       18
                                               RECOVER BATT1     00  .000 VDC
                                               RECOVER BATT2     00  .000 VDC
```

Fig. 11. Spacecraft Telemetry Data Print-out (Biosatellite B, orbit 13)

Figure 2. Spacecraft telemetry data print-out.(Biosatellite B, orbit 13)

BIOSATELLITE B REAL TIME VEHICLE 301

FRAME 098 GMT 251 17 29 51 ORBIT NO. 13F STATION FT. MYERS

EXPERIMENT	TEMPERATURES				EXPERIMENT	TEMPERATURES				EXPERIMENT EVENTS			
THA151	P 1017	31	68.0	DEF	THA171	P 1047	29	66.1	DEF	A200	P 1020	55	0 SW/CL
THA152	P 1017	31	68.0	DEF	THA172	P 1047	29	66.1	DEF				
THA153	P 1017	31	68.0	DEF	THA173	P 1047	29	66.1	DEF	A201	P 1035	36	1,2 SW/CL
THA154	P 1017	31	68.0	DEF	THA174	P 1047	29	66.1	DEF	A202	P 1035	55	0 SW/CL
										A203	P 1035	55	0 SW/CL
THA156	P 1020	20	67.0	DEF	THA179	P 1079	30	67.1	DEF	A204	P 1035	50	1 SW/CL
THA157	P 1020	21	67.7	DEF	THA180	P 1079	32	68.9	DEF	A205	P 1035	50	1 SW/CL
THA158	P 1020	20	67.0	DEF	THA181	P 1079	31	68.0	DEF	A206	P 1035	37	1,2 SW/CL
THA159	P 1020	20	67.0	DEF	THA182	P 1079	31	68.0	DEF	A207	P 1035	36	1,2 SW/CL
					THA183	P 1079	30	67.1	DEF	A208	P 1035	36	1,2 SW/CL
THA160	P 1035	30	67.1	DEF						A209	P 1035	36	1,2 SW/CL
THA161	P 1035	30	67.1	DEF	THA184	P 1123	28	65.2	DEF	A210	P 1035	50	1 SW/CL
THA162	P 1035	30	67.1	DEF	THA185	P 1123	31	68.0	DEF				
THA163	P 1035	30	67.1	DEF						A211	1035/47	55	0 SW/CL
					THA186	P 1135	28	65.2	DEF				
THA164	P 1037	28	65.2	DEF	THA187	P 1135	30	67.1	DEF	A212	P 1047	03	1,2,3 SW/CL
THA165	P 1037	30	67.1	DEF	THA188	P 1135	30	67.1	DEF	A213	P 1047	50	1 SW/CL
THA166	P 1037	30	67.1	DEF	THA189	P 1135	30	67.1	DEF				
THA167	P 1037	31	68.0	DEF						A148	TAPE	OFF	
THA168	P 1037	31	68.0	DEF	THA190	P 1159	28	65.4	DEF	A150	SOURCE	OPEN	
					THA191	P 1159	30	67.1	DEF	A155	CAMERA	CLSE	
THA169	P 1039	47	84.3	DEF									
THA170	P 1039	47	84.2	DEF	THA192	P 1160	28	65.4	DEF				
					THA193	P 1160	30	67.1	DEF				

Fig. 12. Spacecraft Telemetry Data Print-out (Biosatellite B, orbit 13)

CHECK LIST

ORBIT # 13

STATION Ft. Myers

GMT 251 17 29 19

[illegible]	Designation	Diol. Problem Limits	Value	Status	Comment
[illegible]	Roll	.20°/sec	-.238		
[illegible]	Pitch	.20°/sec	.083		
[illegible]	Yaw	.20°/sec	-.100		
[illegible]	Incentive Temp.	75° to 65°F	64.5		
[illegible]	R.H.	40 to 70 RH	58.2		
[illegible]	Total Press.	13.2 to 16.2	14.5		
[illegible]	PO_2	139 to 169 mm Hg	146		
[illegible]	Power Curr.		.116		
[illegible]	Air Tank P.		3481		
[illegible]	N_2 Tank P.		2280		
[illegible]	Capsule T. (1)	75 to 65° F	47.3		
[illegible]	Capsule T. (2)	75 to 65° F	79.0		
[illegible]	Orbit Batt.	Voltage 28	26.6		
[illegible]	Orbit Batt.	Amperage	4.29		
[illegible]	45 VDC		4.88		

Fig. 13.

NASA - AMES RESEARCH CENTER

BIOSATELLITE ORBITAL TEMPERATURES

ORBITS 13F

TIME 1729 19

FLIGHT + 4 HRS

TIME 2129

EXPERIMENT	DOSE	A NO.	FLIGHT	NO. 1 CONTROL FLIGHT SIMULATION (1727)	NO. 2 CONTROL CONSTANT TEMPERATURE	NO. 3 CONTROL VARIABLE TEMPERATURE	NO. 3 CONTROL VARIABLE TEMP. CLINOSTAT
P-1017 PEPPER	NONE	151	68	72	–	67	68
	NONE	152	68	71	–		68
	NONE	153	68	71	–		68
	NONE	154	68	72	–		67
P-1020 WHEAT	NONE	156	67	70	71	67	67
	NONE	157	68	69	↓		
	NONE	158	67	70	↓		
	NONE	159	67	70	↓		
P-1035 AMOEBA	NONE	160	67	70	71	67	
	NONE	161	67	70	↓		
	NONE	162	67	70	↓		
	NONE	163	67	70	↓		
P-1037 NEUROSPORA	NONE	164	65	72	71	66	
	500	165	67	69	↓	67	
	2500	166	67	69	↓		
	1000	167	68	69	↓		
	6000	168	68	69	↓		
P-1039 TRIBOLIUM	NONE	169	85	85			
	1300	170	84	86			
P-1047 FROG EGG	NONE	171	66	–	71	67	
	NONE	172	66	70	↓		
	NONE	173	66	70	↓		
	NONE	174	66	70	↓		
P-1079 MACROBRACON	NONE	179	67	70	71	66	
	2000	180	69	69	↓	67	
	1000	181	69	69	↓		
	4000	182	68	69	↓		
	500	183	67	69	↓		
P-1123 TRADESCANTIA	NONE	184	65	70		65	
	300	185	68	69			
P-1125 LYSOGENIC BACTERIA	NONE	186	65	–		65	
	500	187	67	69			
	2500	188	67	69			
	1000	189	67	69			
P-1159 ADULT DROSOPHILA	NONE	190	65	70	71	66	
	2000	191	67	69	↓		
P-1160 LARVA DROSOPHILA	NONE	192	65	70	71	66	
	1300	193	67	69	↓	67	
				R.H. 54%	64%		

FLIGHT CAPSULE AVERAGE TEMP.

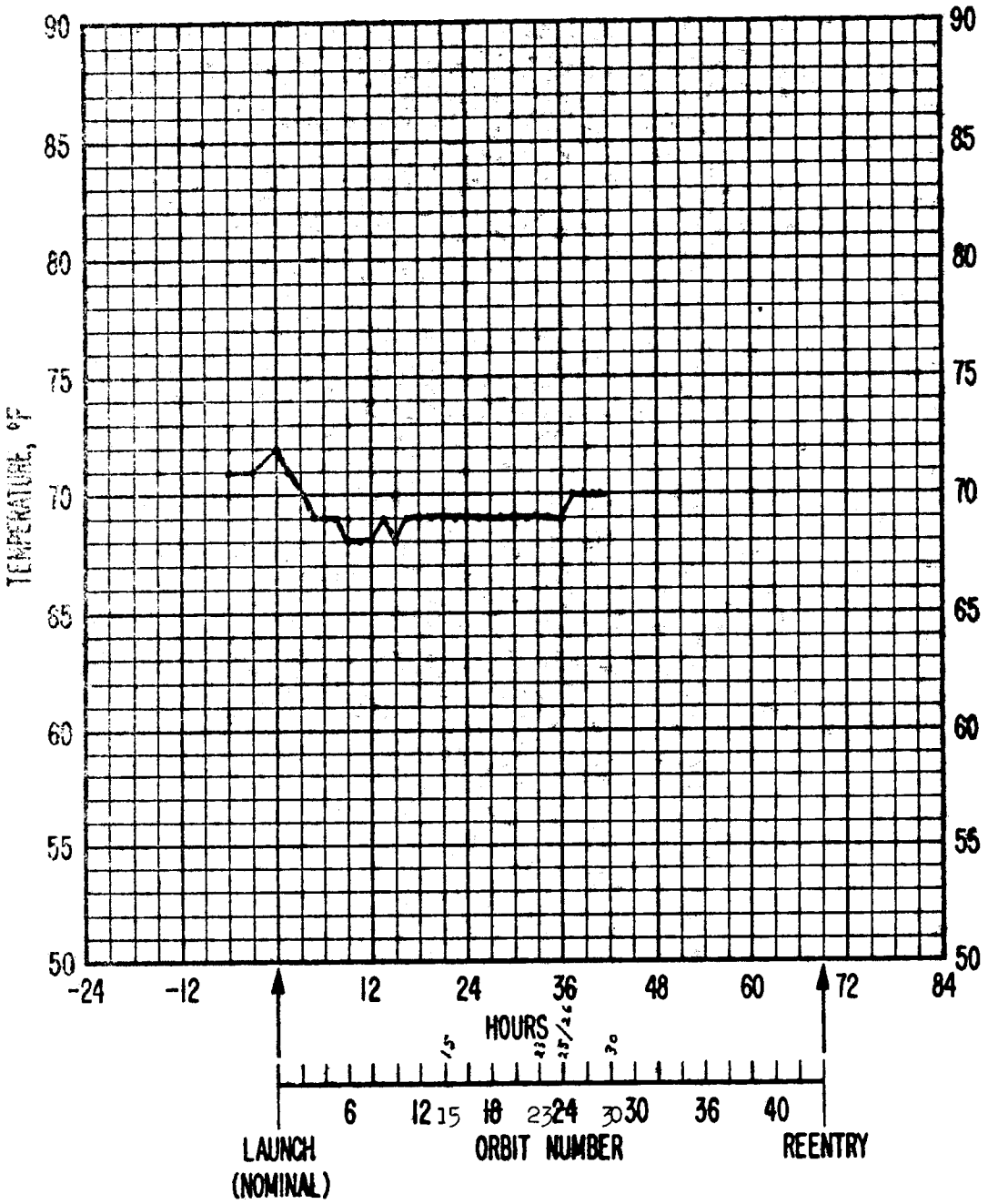
FWD	68
AFT	67
LYSO	

ARC 536 (REV JUN 67) Previous editions of this form are obsolete

Fig. 14

BIOSATELLITE EXPERIMENT TEMPERATURES

EXPERIMENT HABROBRACON A-180 EXPERIMENT NO. P-1079



ARC 537 (NOV 66)

Fig. 15

VII. SURVIVAL OF HABROBRACON MALES AND FEMALES IN THE BIOSATELLITE II EXPERIMENT

Roger H. Smith
A. M. Clark
T. J. Mizianty
L. R. Valcovic
M. B. Baird
Mary Lou Pardue
Katherine T. Cain
Joan W. Reel
Martha S. Jones
Judy A. Winchester
Ruth Ann Carpenter
A. C. Hoffman

The data in this report comprise the number and survival frequency of the Habrobracon in every module in the spacecraft and the ground-based control set-ups.

Results and Discussion

All of the Habrobracon males and females survived, whether they had been in the spacecraft or were from the series of ground-based controls. The complete data are listed in Tables 6-9. The flight-spare packages were kept as extra packages in the control III series after the launch.

This is the first experiment in which 100% survival frequency has been obtained where the Habrobracon were held in the modules for a prolonged period of time. Survival was high for three reasons: (1) the experiment was two-thirds as long as previous tests; (2) the males and females had only recently emerged before the launch; and (3) the Habrobracon had been vigorously selected to obtain the largest possible Habrobracon specimens for the experiment.

Table 6. Survival of males in the flight packages

Packages	Package Position	Package Number	Nominal Dose (R)	Module Position	No. of Wasps	No. of Survivors	Survival
Flight	A822	(G3-5)	4000	UR	20	20	1.00
				LL	20	20	1.00
	A820	(G1-1)	2000	UR	20	20	1.00
				LL	20	20	1.00
	A821	(G1-3)	1000	UR	20	20	1.00
				LL	20	20	1.00
	A823	(G1-2)	500	UR	20	20	1.00
				LL	20	20	1.00
	A810	(G4-17)	0	UR Inner	20	20	1.00
			0	Middle	20	20	1.00
			0	Outer	20	20	1.00
			pre-2000	LL Inner	20	20	1.00
			0	Middle	20	20	1.00
			0	Outer	20	20	1.00
Flight spare		(G3-12)	0	UR	20	20	1.00
			0	LL	20	20	1.00
		(G1-8)	0	UR	20	20	1.00
			0	LL	19	19	1.00
		(G4-19)	0	UR Inner	20	20	1.00
			0	Middle	19	19	1.00
			0	Outer	20	20	1.00
			pre-2000	LL Inner	21	21	1.00
			0	Middle	20	20	1.00
			0	Outer	20	20	1.00

Table 7. Survival of males in the control packages

Packages	Package Number	Nominal Exposure (R)	Module Position	No. of Wasps	No. of Survivors	Survival
Control I	1	4000	UL	20	20	1.00
			LR	20	20	1.00
	2	2000	UL	20	20	1.00
			LR	20	20	1.00
	3	1000	UL	20	20	1.00
			LR	20	20	1.00
	4	500	UL	20	20	1.00
			LR	19	19	1.00
	5	pre-2000	UL Inner	20	20	1.00
		0	Middle	20	20	1.00
		0	Outer	20	20	1.00
		0	LR Inner	20	20	1.00
		0	Middle	20	20	1.00
		0	Outer	20	20	1.00
Control II	35	pre-2000	UL	20	20	1.00
		0	LR	19	19	1.00
	40	0	UL	20	20	1.00
		0	LR	20	20	1.00
	43	0	UL	20	20	1.00
		0	LR	20	20	1.00
Control III	42	pre-2000	UL	19	19	1.00
		0	LR	20	20	1.00
	41	0	UL	19	19	1.00
		0	LR	20	20	1.00
	36	0	UL	20	20	1.00
		0	LR	20	20	1.00

Table 8. Survival of females in the flight packages

Packages	Package Position	Package Number	Nominal Dose (R)	Module Position	No. of Wasps	No. of Survivors	Survival
Flight	A822	(G3-5)	4000	UL	19	19	1.00
				LR	20	20	1.00
	A820	(G1-1)	2000	UL	20	20	1.00
				LR	20	20	1.00
	A821	(G1-3)	1000	UL	20	20	1.00
				LR	20	20	1.00
	A823	(G1-2)	500	UL	20	20	1.00
				LR	19	19	1.00
	A810	(G4-17)	pre-2000	UL Inner	20	20	1.00
			0	Middle	20	20	1.00
			0	Outer	20	20	1.00
			0	LR Inner	20	20	1.00
			0	Middle	20	20	1.00
			0	Outer	20	20	1.00
Flight spare		(G3-12)	0	UL	20	20	1.00
			0	LR	19	19	1.00
		(G1-8)	0	UL	20	20	1.00
			0	LR	20	20	1.00
		(G4-19)	pre-2000	UL Inner	20	20	1.00
			0	Middle	20	20	1.00
			0	Outer	20	20	1.00
			0	LR Inner	20	20	1.00
			0	Middle	21	21	1.00
			0	Outer	20	20	1.00

Table 9. Survival of females in the control packages

Packages	Package Number	Nominal Exposure (R)	Module Position	No. of Wasps	No. of Survivors	Survival
Control I	1	4000	UR	20	20	1.00
			LL	20	20	1.00
	2	2000	UR	20	20	1.00
			LL	20	20	1.00
	3	1000	UR	20	20	1.00
			LL	19	19	1.00
	4	500	UR	20	20	1.00
			LL	20	20	1.00
	5	0	UR Inner	20	20	1.00
		0	Middle	20	20	1.00
		0	Outer	20	20	1.00
		pre-2000	LL Inner	20	20	1.00
		0	Middle	20	20	1.00
		0	Outer	20	20	1.00
Control II	35	0	UR	20	20	1.00
		pre-2000	LL	20	20	1.00
	40	0	UR	20	20	1.00
		0	LL	20	20	1.00
	43	0	UR	20	20	1.00
		0	LL	20	20	1.00
Control III	42	0	UR	19	19	1.00
		pre-2000	LL	20	20	1.00
	41	0	UR	20	20	1.00
		0	LL	20	20	1.00
	36	0	UR	20	20	1.00
		0	LL	20	20	1.00

VIII. POST-FLIGHT MATING BEHAVIOR OF MALES IN THE BIOSATELLITE II EXPERIMENT

L. R. Valcovic
Mary Lou Pardue
Martha S. Jones
R. C. von Borstel
A. M. Clark
M. B. Baird
Ruth Ann Carpenter
Roger H. Smith

A major time-consuming activity associated with any mutation-induction experiment on Habrobracon sperm is the observed individual matings of the treated Habrobracon males. This is essential because the females (who do not need to mate in order to produce viable haploid offspring) are occasionally unwilling to mate. In order to assess the damage to sperm, mating, with the subsequent production of fertilized eggs, is mandatory.

Results

A marked difference was observed in the mating behavior of males that had been in the spacecraft and the mating behavior of males that had been in the ground-based control set-up and the control incubators. In both cases the females were willing to mate. The observed matings of males from the ground-based control set-up and the control incubators were rapidly achieved in about 3 hr by three investigators. This constituted 243 observed individual matings, that is, one observed mating for every male.

On the other hand, with the 254 spacecraft males that needed mating, the process took over 13 hr with certainty established for fewer than one-third of the matings. Again observations on the individual matings were carried out by three investigators.

The males that had been on the spacecraft tried to mate, but they seemed disoriented and unable to find or make contact with the females. The females at no time were reluctant, although females often become reluctant after prolonged mating attempts by males.

This disorientation persisted during the entire time that the observed matings were being made prior to transporting the mating pairs to Oak Ridge for the genetic studies. During the transportation, which took place between 0500 and 1800 EDT, September 11, the males must have recovered, because the genetic studies demonstrated that 80.3% matings took place with the males that were in the spacecraft (Table 10). This compared favorably to 93.0% matings that took place with the males that were in the ground-based control set-up and control incubators.

Discussion

A disorientation of normal males which interferes with normal mating behavior has never before been observed. Mutants have been found, however, that are "lethal" because the males are disoriented during mating.

It is tempting to associate the disorientation of the males with spaceflight factors, but no ground-based control experiment was carried out at the laboratory at Hickam Field to verify this. The reason that experiments on mating behavior were not conducted is that the result was entirely unexpected, thus no normal males were available at the Hickam Field Laboratory. Only virgin females had been brought from Cape Kennedy.

Summary

There is reason to believe that a spaceflight factor is associated with disorientation of mating behavior of Habrobracon males.

Table 10. Frequencies of matings accomplished by males carried on the Biosatellite II spacecraft and by those remaining in the ground-based control set-up

Position	Nominal Exposures (R)				Layers of Control Modules (no exposure)		
	4000	2000	1000	500	Inner	Middle	Outer
Spacecraft UL	12/18*	15/17	16/18	16/18	15/18 (pre-2000)	16/18	11/19
Spacecraft LR	13/18	17/19	17/18	16/18	14/19	17/19	9/17
Totals:	25/36	32/38	33/36	32/36			
Grand Total:	204/254 — 80.31%						
Ground Control I UL	18/20	14/20	17/18	18/20	16/17	—	14/15
Ground Control I LR	16/16	16/18	19/20	18/18	—	—	17/17
Totals:	34/36	30/38	36/38	36/38			
Grand Total:	226/243 — 93.00%						
Ground Control III UL					18/19 (pre-2000)		16/16
Ground Control III LR					—		—
Pretest (9/9)							

*All fractions designate mated females/total females.

IX. SUPPLEMENT TO STANDING INSTRUCTIONS AND FLIGHT-TIME INSTRUCTIONS FOR THE HABROBRACON (P-1079) EXPERIMENT IN THE THREE-DAY BIOSATELLITE

[See Standing Instructions and Flight-Time Instructions in ORNL-TM-1957, Quarterly Progress Report to NASA covering the period October 1 - December 31, 1966]

2. Pre-Flight Operations at Cape Kennedy and Hickam Field

2.10 Dominant Lethal Analysis of Habrobracon Irradiated Prior to Package Assembly

2.10 Dominant lethal analysis of Habrobracon irradiated prior to package assembly

2.10.1.0 Scope: This instruction covers a pre-flight control for the Biosatellite experiment. In this test, Habrobracon females and males which are irradiated at the same time as the pre-irradiated group are analyzed immediately

2.10.2.0 Instruction 4.2. is followed in its essentials except that 24 males and 24 females are analyzed instead of 960 of each

5. Personnel Assignments

(This section parallels Section 5 of ORNL-TM-1957, Quarterly Progress Report to NASA covering the period October 1 - December 31, 1966, but the details differ)

5.1 Deployment of Personnel

5.1. Deployment of personnel

5.1.1.0 Scope: This instruction describes the most economical and efficient placement of the Habrobracon investigators in their working capacities at Cape Kennedy, Goddard Space Flight Center, Hickam Field, Raleigh, and Oak Ridge. The assignments of specific individuals are listed in instruction 5.1.6. (Appendix)

5.1.2.0 Cape Kennedy

5.1.2.1 The work at Cape Kennedy prior to flight requires the efforts of five investigators to properly prepare the Habrobracon which are to be used in the ground-based controls and the flight

5.1.2.2 As the flight approaches, more individuals are required for the pre-flight operations

5.1.2.3 On T-3, four more individuals are brought to Cape Kennedy for the final pre-flight operations and the assembly

5.1.2.4 On T+1 days, two of the individuals at Cape Kennedy go to Hickam Field to participate in the post-flight operations there

5.1.2.5 The seven people left at Cape Kennedy share the in-flight duties

5.1.2.6 The post-flight operations at Cape Kennedy occupy the seven people for varying lengths of time, until the experiment is moved to Raleigh and to Oak Ridge

5.1.2.7 Two persons must necessarily go to Cape Kennedy on T+15 to T+20 to make final adult survival analyses on the portion of the experiment left there

5.1.3.0 Hickam Field

5.1.3.1 Two individuals go to Hickam Field at T-12 and T-10 to carry out pre-flight operations and prepare the laboratory

5.1.3.2 One person goes from Raleigh to Hickam Field on T+1 and another goes from Oak Ridge on T+1

5.1.3.3 One half of the experiment remains at Hickam Field for 5 days with three individuals in attendance, and the other half of the experiment is returned to Oak Ridge

5.1.4.0 Goddard Space Flight Center

5.1.4.1 One investigator from the Habrobracon group carries out the operations at Goddard Space Flight Center and is on instant call for decisions regarding the disposition of the Biosatellite should an emergency arise

5.1.4.2 This person arrives at Goddard Space Flight Center on T-2, carries out in-flight operations, and departs on T+6

5.1.5.0 Oak Ridge

5.1.5.1 One person remains at Oak Ridge and carries out the necessary operations for post-flight activities

5.1.5.2 It is important that this person be thoroughly versed in all operations involving Habrobracon and that a state of complete readiness be achieved for glassware, laboratory apparatus, and host Ephestia larvae

5.1.6. Appendix — Position Assignments of Specific Investigators

Habrobracon P-1079

Location of personnel for pre-flight, in-flight, and post-flight operations

O — Oak Ridge
R — Raleigh
C — Cape Kennedy
H — Hickam Field
G — Goddard

	August						September						↑		↓											
	S 26	S 27	M 28	T 29	W 30	T 31	F 1	S 2	S 3	M 4	T 5	W 6	T 7	F 8	S 9	S 10	M 11	T 12	W 13	T 14	F 15	S 16	S 17	M 18	T 19	W 20
	T- 12	11	10	9	8	7	6	5	4	3	2	1	Launch 0	T+ 1	Recovery 2	3	4	5	6	7	8	9	10	11	12	13
Amy, R. L.											G	G	G	G	G	G	G	Home								
Baird, M. B.	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	O	O	O	O	O	Home				
Carpenter, R. A.	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	R	R	R	R	R	R	R	R
Clark, A. M.										C	C	C	C	C	C	C	Home									
Cain, K. T.										C	C	C	C	C	C	C	C	C	O	O	O	O	O	O	O	O
Grosch, D. S.															H	H	H	H	R	R	R	R	R	R	R	R
Hoffman, A. C.	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	R	R	R	R	R	R	R	R	R
Jones, M. S.	O	O	O	O	O	O	O	O	O	O	O	O	H	H	H	H	O	O	O	O	O	O	O	O	O	O
Lane, M. J.	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Mizianty, T. J.										C	C	C	C	C	C	C	O	O	O	O	O	Home				
Pardue, M. L.										C	C	C	C	H	H	H	O	O	O	O	O	Home				
Reel, J. W.	O	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	O	O	O	O	O	O	O	O
Smith, R. H.	C	C	C	Genetics Soc. Meeting				O	C	C	C	C	C	C	C	C	O	O	O	O	O	O	O	O	O	O
Valcovic, L. R.	R	R	R	R	R	R	R	R	R	R	H	H	H	H	H	H	H	O	O	O	O	O	R	R	R	R
von Borstel, R. C.	H	H	O	O	O	O	O	O	O	Chromosome Conference																
Winchester, J. A.	C	C	C	C	C	C	C	C	C	C	C	C	C	H	H	H	H	H	O	O	O	O	O	O	O	O

5.2 Assembly Teams

5.2. Assembly teams

5.2.1.0 Scope: This instruction lists the assignments and names of the investigators during the loading and assembly of the Habrobracon packages for the Biosatellite experiment and its ground-based controls

5.2.2.0 Phase I — Loading of Habrobracon

5.2.2.1.0 Team A: Ground Controls I and II

5.2.2.1.1 K. T. Cain (check)

5.2.2.1.2 T. J. Mizianty (torque caps)

5.2.2.1.3 J. A. Winchester (load ♂♂)

5.2.2.1.4 M. B. Baird (load ♀♀)

5.2.2.2.0 Team B: Flight and Ground Control III

5.2.2.2.1 R. H. Smith (check)

5.2.2.2.2 A. M. Clark (torque caps)

5.2.2.2.3 R. A. Carpenter (load ♂♂)

5.2.2.2.4 M. L. Pardue (load ♀♀)

5.2.3.0 Phase II — Assembly of Package

5.2.3.1.0 Team A: Ground Controls I and II

5.2.3.1.1 K. T. Cain (check and make dosimetry map)

5.2.3.1.2 T. J. Mizianty (attach radiation shields)

5.2.3.1.3 J. A. Winchester (torque modules into brackets)

5.2.3.1.4 M. B. Baird (put modules into brackets)

5.2.3.2.0	Team B: Flight and Ground Control III
5.2.3.2.1	R. H. Smith (check and make dosimetry map)
5.2.3.2.2	A. M. Clark (attach radiation shields)
5.2.3.2.3	R. A. Carpenter (torque modules into brackets)
5.2.3.2.4	M. L. Pardue (put modules into brackets)
5.2.4.0	Recorder: A. C. Hoffman

5.3 Deployment for Shift Duties During the Flight

5.3.	Deployment for shift duties during the flight
5.3.1.0	Scope: This instruction lists the names of personnel who will be on shift duty at Cape Kennedy during in-flight operations
5.3.2.0	0800-1615
5.3.2.1	A. M. Clark
5.3.2.2	K. T. Cain
5.3.2.3	R. A. Carpenter
5.3.3.0	1600-0015
5.3.3.1	R. H. Smith
5.3.3.2	M. B. Baird
5.3.4.0	0000-0415
5.3.4.1	A. C. Hoffman
5.3.5.0	0400-0815
5.3.5.1	T. J. Mizianty

5.4. Disassembly Teams

5.4. Disassembly teams

5.4.1.0 Scope: This instruction lists the names of personnel involved in disassembly operations and gives their assigned duties

5.4.2.0 Hickam Field

5.4.2.1.0 Disassembly of Habrobracon packages

5.4.2.1.1 J. W. Reel

5.4.2.1.2 M. L. Pardue

5.4.2.2.0 Setting Habrobracon females from flight

5.4.2.2.1 J. A. Winchester

5.4.2.2.2 J. W. Reel (as soon as she has completed disassembly operations)

5.4.2.3.0 Mating of males from flight with virgin females

5.4.2.3.1 L. R. Valcovic

5.4.2.3.2 M. S. Jones

5.4.2.3.3 M. L. Pardue (as soon as she has completed disassembly operations)

5.4.2.4.0 Unloading of radiation exposure detectors

5.4.2.4.1 M. L. Pardue

5.4.2.4.2 J. W. Reel

5.4.3.0 Cape Kennedy

5.4.3.1.0 Disassembly of Habrobracon packages

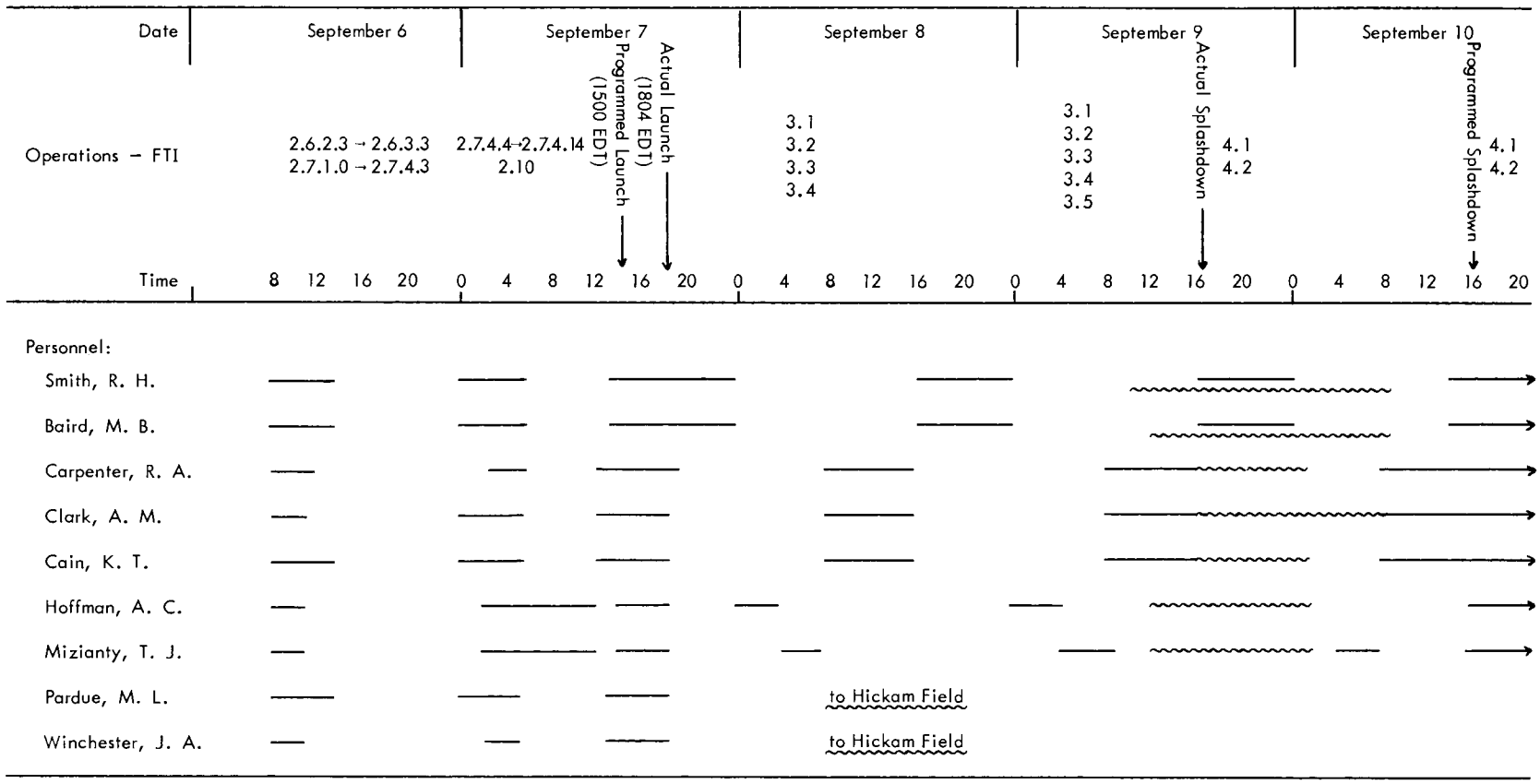
5.4.3.1.1 R. H. Smith

5.4.3.1.2 K. T. Cain

5.4.3.2.0	Setting Habrobracon females from the ground-based control set-up
5.4.3.2.1	M. B. Baird
5.4.3.2.2	R. H. Smith (as soon as he has completed disassembly operations)
5.4.3.3.0	Mating of males from the ground-based control set-up with virgin females
5.4.3.3.1	A. M. Clark
5.4.3.3.2	R. A. Carpenter
5.4.3.3.3	T. J. Mizianty
5.4.3.3.4	A. C. Hoffman
5.4.3.3.5	K. T. Cain (as soon as she has completed disassembly operations)
5.4.3.3.6	M. B. Baird (as soon as he has completed the setting of Habrobracon females)
5.4.3.3.7	R. H. Smith (as soon as he has completed the setting of Habrobracon females)
5.4.3.4.0	Unloading of radiation exposure detectors
5.4.3.4.1	K. T. Cain
5.4.3.4.2	M. B. Baird

Habrobracon P-1079

Schedule at Cape Kennedy from T-23 hr to the time of recovery



Programmed schedule

Schedule followed becouse of the early call-down of Biosatellite II

INTERNAL DISTRIBUTION

1. M. A Bender
2. S. F. Carson
3-22. F. J. de Serres
23. A. Hollaender
24. W. H. Jordan
25. R. F. Kimball
26. C. E. Larson
27-36. J. L. Liverman
37. A. J. Miller
38. K. Z. Morgan
39. R. A. McNees
40. H. G. MacPherson
41. Diana B. Smith
42-52. R. H. Smith
53-152. R. C. von Borstel
153. Anna R. Whiting
154. A. M. Weinberg
155-164. Biology Division Editorial Office
165. Biology Library
166-167. Central Research Library
168. ORNL — Y-12 Technical Library, Document Reference Section
169-173. Laboratory Records Department
174. Laboratory Records, ORNL R.C.
175. ORNL Patent Office

EXTERNAL DISTRIBUTION

176. Dr. R. L. Amy, Department of Biology, Southwestern University, Memphis, Tennessee
177. Mr. M. B. Baird, Department of Biology, University of Delaware, Newark, Delaware
178-183. Dr. N. Barr, Division of Research, U. S. Atomic Energy Commission, Washington, D.C.
184. Dr. A. M. Clark, Department of Biology, University of Delaware, Newark, Delaware
185. Dr. John R. Totter, Director, Division of Biology and Medicine, U. S. Atomic Energy Commission, Washington, D.C.
186. Dr. C. W. Edington, Chief, Biology Branch, Division of Biology and Medicine, U. S. Atomic Energy Commission, Washington, D.C.
187. Dr. D. S. Grosch, Department of Genetics, North Carolina State University, Raleigh, North Carolina
188. Dr. John E. Hewitt, Ames Research Center, Moffett Field, California
189. Capt. Walter Jones, Director, Biotechnology and Human Research, Office of Advanced Research and Technology, NASA, Washington, D.C.
190. Dr. W. Keller, Space Vehicle Research and Technology, Office of Advanced Research and Technology, NASA, Washington, D.C.
191. Dr. K. Kojima, Department of Zoology, University of Texas, Austin, Texas

192. Dr. Sohei Kondo, Faculty of Medicine, Osaka University, Osaka, Japan
193. Dr. L. E. LaChance, Metabolism and Radiation Research Laboratory, USDA State University Station, Fargo, North Dakota
194-218. Miss Winnie M. Morgan, Technical Reports Office, Grants and Research Contracts, Office of Space Sciences, NASA, Washington, D.C.
219. Miss Mary Lou Pardue, Department of Biology, Yale University, New Haven, Connecticut
220-244. Mr. T. Smull, Director, Grants and Research Contracts, Office of Space Sciences, NASA, Washington, D.C.
245. Dr. John W. Tremor, Ames Research Center, Moffett Field, California
246. Mr. L. R. Valcovic, Department of Genetics, North Carolina State University, Raleigh, North Carolina
247-248. Biotechnology and Human Research, Office of Advanced Research and Technology, NASA, Washington, D.C.
249-251. Director, Bio-Science Programs, Office of Space Sciences, NASA, Washington, D.C.
252-266. Division of Technical Information Extension
267. Laboratory and University Division, AEC, ORO
268. Dr. Thomas J. Mizianty, Department of Biology, Wilkes College, Wilkes-Barre, Pennsylvania
269. Dr. B. B. Webber, Department of Biology, Augusta College, Augusta, Georgia
270. Mr. John A. Rock, 208 22nd Street, New Orleans, Louisiana