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BIOLOGY DIVISION PROGRESS REPORT TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

TASK NO. 8, BIOSATELLITE PROGRAM

Experiment Proposal No. P-1037
Principal Investigator: F. J. de Serres

SECTION 1. Mutagenic effectiveness of known doses of gamma irradiation in combination with zero gravity in Neurospora. (Period: July 1 — September 30, 1967)

SECTION 2. Mutagenic effectiveness of known doses of gamma irradiation in combination with zero gravity in Neurospora. (Period: October 1 — December 31, 1967)

Experiment Proposal No. P-1079
Principal Investigator: R. C. von Borstel

SECTION 3. Mutagenic effectiveness of known doses of gamma irradiation in combination with weightlessness on Habrobracon. (Period: July 1 — September 30, 1967)

SECTION 4. Mutagenic effectiveness of known doses of gamma irradiation in combination with weightlessness on Habrobracon. (Period: October 1 — December 31, 1967)

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SECTION 1

BIOLOGY DIVISION

NEUROSPORA EXPERIMENT P-1037

QUARTERLY PROGRESS REPORT

TO THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

JULY 1 — SEPTEMBER 30, 1967

(Printed separately as ORNL-TM-2235)

ORNL-TM-2235

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

QUARTERLY PROGRESS REPORT
TO THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Title of Project:

Mutagenic Effectiveness of Known Doses of Gamma Irradiation in Combination with Zero Gravity on Neurospora

For the Period:

July 1 – September 30, 1967

Principal Investigator:

Frederick J. de Serres

Coinvestigator:

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Interagency Agreement:

Purchase Order R-104, Task No. 8

Experiment Proposal No.:

P-1037

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.

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I. INTRODUCTION

Previous quarterly reports in this series are ORNL-TM 1734, ORNL-TM 1959, ORNL-TM 2189, and ORNL-TM 2190. The first of these includes results of early experiments (1) to determine the genetic effects of ^{85}Sr irradiation by estimating the frequencies of recessive lethal mutations at specific loci with a two-component heterokaryon of Neurospora crassa, (2) to determine the effects of anoxia, and (3) to evaluate the prototype and flight hardware in a series of biocompatibility tests performed in connection with the qualification and acceptance tests of the hardware in Philadelphia. ORNL-TM 1959 is concerned primarily with the tests, launch simulations, and gantry exercises at Cape Kennedy prior to the Biosatellite A flight as well as the preparations for flight of Biosatellite A. ORNL-TM 2189 describes the Neurospora experiment in the Biosatellite A flight and the analysis of the ground-control samples from this flight attempt. Some of the IBM data-collection sheets and data print-outs are also described and illustrated in this report. ORNL-TM-2190 describes the Con-Rad passive dosimetry system used in our early work and our attempts to identify some of the sources of variation in the data obtained with this system.

The present report discusses the following activities during the period July 1–September 30, 1967: (1) the radiation dosimetry test at Cape Kennedy in July, (2) the 201 Gantry Exercise at Cape Kennedy, (3) the 301 Gantry Exercise at Cape Kennedy, and (4) preparation for and completion of the successful Biosatellite B flight.

II. RADIATION-DOSIMETRY TEST AT CAPE KENNEDY

On July 17-20, in the Hangar S Annex at Cape Kennedy, dosimeters of three different types were inserted into the Neurospora experiment hardware and the individual packages were placed in the fore and aft sections of the 201 spacecraft. Attached to each package were tubes of lithium fluoride powder supplied by Ames Research Center. Three 12-hr exposures to gamma rays from an 85-strontium source were completed during the 4-day period. Representatives conducting the Tribolium, Habrobracon, and Tradescantia experiments carried out similar tests with their hardware, so that Ames Research Center personnel could estimate the radiation exposures to the biological samples in each of the radiation experiments.

The purposes of the experiment were: (1) to estimate in advance the radiation exposures that would be received by the biological samples in each of the radiation experiments in the Biosatellite II flight; (2) to provide the basis for an independent estimate of the exposures to be received in the Biosatellite II flight by extrapolating from thermoluminescence readings of the LiF powder to be irradiated, during flight, in positions on the exterior surface of the individual assemblies; (3) to estimate that portion of the ionizing radiation exposures resulting from low-energy scattered radiation; (4) to permit the experimenters to obtain experience with the thermoluminescent dosimetry systems, and to test the procedures for comparing the results obtained with the various systems; and (5) to obtain a calibration curve with ^{85}Sr gamma radiation (with individually calibrated dosimeters) and thus provide a basis for comparing data obtained by different experimenters with different dosimetric systems.

Because the description of some of the developmental work on the dosimetry system has not yet been completed, the detailed results from the Cape Kennedy test will be described in a subsequent report. In brief, it is possible to obtain separate estimates of the roentgen exposures from three different types of dosimeters (i.e.,

E.G. & G. LiF dosimeters, E.G. & G. CaF_2:Mn dosimeters, and Con-Rad LiF teflon-disk dosimeters) which are in good agreement. Furthermore, it was shown during this exercise that scattered radiation with energy of less than about 100 kev represented an average of 6.3% of the total exposure to the Neurospora samples.

III. 201 GANTRY EXERCISE

The 201 Gantry Exercise was performed in two separate steps. The first portion of the test required the experiment teams to prepare the biological materials and to coordinate their work with other groups on schedule. The biological materials were taken to the clean room in their individual assemblies and loaded into the fore and aft payloads on schedule. The payloads were placed into their carrying cases and vehicles, and these were moved as far as the door of Hangar S. After this, the payloads were disassembled and the biological materials were returned to the experimental teams in their individual assemblies. This first portion of the test was carried out with a simulated launch count-down time on August 3, 1967, and provided much-needed practice for both the new module-preparation team at ORNL and the assembly-coupling team at Cape Kennedy. At a later time, the second half of the 201 Gantry Exercise was completed, without biological materials; i.e., the assemblies and payloads were transported to the gantry, loaded into the spacecraft, and the count-down and check-outs were continued until just before launch.

Because the 301 Gantry Exercise was scheduled immediately prior to flight, with launch dates of August 28 for the 301 test and September 7 for flight, the Neurospora samples from the 201 Gantry Exercise were used in a forward-mutation exercise at ORNL. In this way, new ORNL personnel could become acquainted with the entire assay procedure and could acquire experience in new responsibilities in the assay procedure. Three modules from the 201 test were selected and irradiated

with 250 kvp X rays (30 mA, 3 mm aluminum extrinsic filtration) so that the first filters received an exposure rate of approximately 500 R/min for 3, 6, or 12 min, respectively. An additional module was retained as an unirradiated control. The conidia from filter Nos. 1 and 2 in the control- and 1500 R-modules, and those from filter Nos. 1, 2, and 3 from the 3000 R- and 6000 R-modules, were suspended and used in platings and jug inoculations in the customary manner. The data from these 201 Gantry Exercise conidia are presented in Table 1, and the average mutation frequencies for each filter sample are plotted in Fig. 1. In this figure, for comparison, some data are included from a previous experiment with conidia on filters which received total exposures of 5000, 10,000, and 20,000 R at a rate of 1000 R/min. The agreement with the forward-mutation frequencies expected by extrapolation of the dose-response curves is excellent, indicating that the procedures had been carried out satisfactorily.

ORNL-BIO-19424

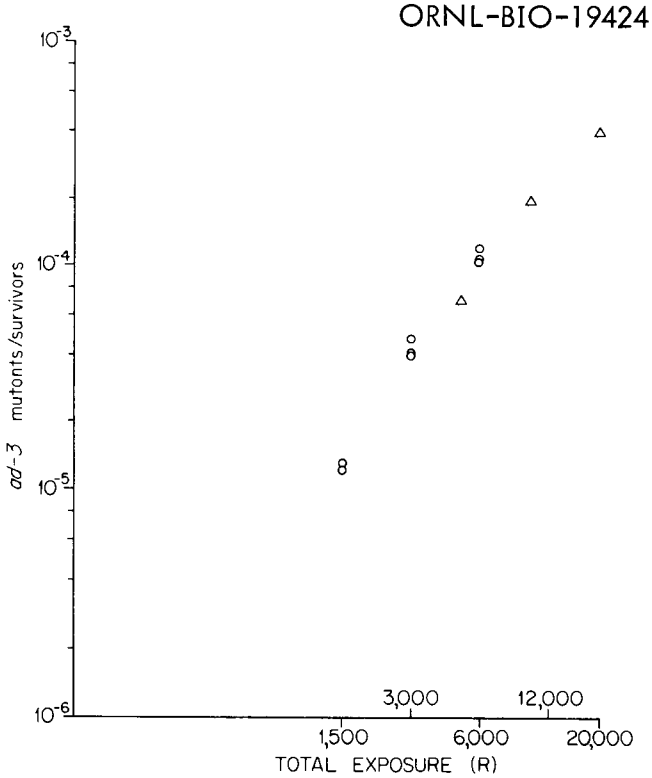

Fig. 1. Treatment Means for the Forward-Mutation Frequencies in Conidia Subjected to Storage in the 201 Gantry Exercise and then to 250 kvp X Rays at 500 R/min

O = X-ray data at 500 R/min from 201 Gantry Exercise; Δ = X-ray data at

Table 1

Data from a forward-mutation experiment inoculated with conidia from the 201 Gantry Exercise of August 1967

Arbitrary Treatment No.	Approximate X-Ray Exposure (R)	Filter No.	Plating Data: Heterokaryotic Survival: Proportion of All Conidia	Plating Data: Heterokaryotic Survival: Percent of Zero Dose (0.2025)	Jug Data: Jug No.	Jug Data: Heterokaryotic Survival: Proportion of All Conidia	Jug Data: Heterokaryotic Survival: Percent of Zero Dose (0.1472)	Jug Data: Purple Colonies	Jug Data: Estimated Background Colonies	Jug Data: Forward Mutation Frequency ($X 10^6$)
1	0	1	0.1934	95.5	1	0.1424	96.7	1	694,720	1.4
					7	0.1522	103.4	0	742,560	0
					37	0.1348	91.6	0	657,760	0
2	0	2	0.2116	104.5	2	0.1950	132.5	1	838,662	1.2
					38	0.1370	93.1	0	589,132	0
					39	0.1391	94.5	0	598,005	0
					40	0.1302	88.5	0	559,861	0
3	1500	1	0.1417	70.0	3	0.1390	94.4	4	586,042	6.8
					12	0.1209	82.1	7	509,763	13.7
					21	0.1114	75.7	7	469,960	14.9
					34	0.1369	93.0	8	577,231	13.9
4	1500	2	0.1149	56.7	4	0.1365	92.7	8	647,473	12.4
					25	0.1289	87.6	8	611,325	13.1
					31	0.1259	85.5	8	591,863	13.4
5	3000	1	0.1151	56.8	5	0.0817	55.5	27	391,959	68.9
					14	0.1256	85.3	29	602,950	48.1
					16	0.1079	73.3	22	517,722	42.5
					23	0.1136	77.2	20	545,140	36.7
6	3000	2	0.1169	57.7	6	0.1081	73.4	20	522,226	38.3
					15	0.0941	63.9	15	454,837	33.0
					24	0.0928	63.0	18	448,339	40.1
					33	0.1198	81.4	29	578,867	50.1
7	3000	3	0.1391	68.7	8	0.1075	73.0	18	469,279	38.4
					17	0.1013	68.8	23	442,309	52.0
					26	0.0753	51.2	16	328,640	48.7
					35	0.1075	73.0	11	469,665	23.4
8	6000	1	0.1162	57.4	9	0.0955	64.9	42	456,625	92.0
					18	0.1062	72.1	64	507,901	126.0
					27	0.0974	66.2	60	465,920	128.8
					30	0.1014	68.9	67	485,109	138.1
9	6000	2	0.1085	53.6	10	0.0946	64.3	51	422,433	120.7
					19	0.1036	70.4	45	462,697	97.3
					22	0.1011	68.7	48	451,827	106.2
					28	0.0900	61.1	40	401,920	99.5
10	6000	3	0.1039	51.3	11	0.1035	70.3	54	446,038	121.1
					20	0.0996	67.7	49	429,113	114.2
					29	0.0972	66.0	46	418,633	109.9
					32	0.1192	81.0	44	513,431	85.7
Means:										
1	0	1	0.1934	95.5	1, 7,37	0.1431	97.2	1	2,095,040	0.5
2	0	2	0.2116	104.5	2,38,39,40	0.1503	102.1	1	2,585,787	0.4
3	1500	1	0.1417	70.0	3,12,21,34	0.1271	86.3	26	2,142,996	12.1
4	1500	2	0.1149	56.7	4,25,31	0.1304	88.6	24	1,850,661	13.0
5	3000	1	0.1151	56.8	5,14,16,23	0.1072	72.8	98	2,057,771	47.6
6	3000	2	0.1169	57.7	6,15,24,33	0.1037	70.4	82	2,004,269	40.9
7	3000	3	0.1391	68.7	8,17,26,35	0.0947	64.3	68	1,709,893	39.8
8	6000	1	0.1162	57.4	9,18,27,30	0.1001	68.0	233	1,915,555	121.6
9	6000	2	0.1085	53.6	10,19,22,28	0.0973	66.1	184	1,738,877	105.8
10	6000	3	0.1039	51.3	11,20,29,32	0.1049	71.3	193	1,807,215	106.8
1 & 2	0		0.2025	100.0		0.1472	(100.0)	2	4,680,700	0.4
3 & 4	1500		0.1283	63.4		0.1299	88.2	50	3,993,657	12.5
5, 6, & 7	3000		0.1237	61.1		0.1029	69.9	248	5,771,933	43.0
8, 9, & 10	6000		0.1095	54.1		0.1007	68.4	610	5,461,647	111.7

IV. 301 GANTRY EXERCISE

For the 301 Gantry Exercise, biological samples were loaded into 15 modules at ORNL on August 24. These modules were transported at ice-water temperature to Cape Kennedy, where they were held in reserve in case of subsequent emergency. The 15 additional modules actually used in the test were loaded on August 26 and were shipped to Cape Kennedy on August 27. A copy of the Requisition and Invoice/ Shipping Document (DD Form 1149) for these modules is included as Table 2. The third set of 15 modules, to be used in case of a test delay of about 2 days, was prepared on August 28 and transported to Cape Kennedy on August 29.

The purpose of the 301 Gantry Exercise was to provide a final check of the actual flight hardware, and to assure that the experiment teams (some of which included relatively inexperienced personnel) could participate effectively in the count-down and flight periods. For the Neurospora experiment, this exercise was completely successful. The count-down for the simulated launch on August 28 was completed on schedule, and the work schedules for coverage of the Hangar S laboratory during the simulated flight period of 3 days by each experimental group were firmly established. It was also possible, at this time, to finalize the schedules of activities for all the experimental groups in case of a possible emergency or delay that might require the preparation of new biological material.

The biological samples from the 301 Gantry Exercise were not analyzed because such analysis would have conflicted with preparations for the actual flight. The dosimeters were saved and used later to estimate the radiation exposures to each of the filters during the 301 Gantry Exercise.

Table 2

SHIPPING CONTAINER TALLY 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

REQUISITION AND INVOICE/SHIPPING DOCUMENT

SHEET NO. 1 / NO. OF SHEETS	5. REQUISITION DATE
6. REQUISITION NO.	
1. FROM	7. DATE MATERIEL REQUIRED
8. PRIORITY	
2. TO	9. AUTHORITY OR PURPOSE
10. SIGNATURE	11a. VOUCHER NUMBER AND DATE
3. SHIP TO -MARK FOR	12. DATE SHIPPED
b. VOUCHER NUMBER AND DATE	13. MODE OF SHIPMENT
14. BILL OF LADING NUMBER	15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NUMBER

1. FROM: NAS-2-1900 ~~Oak Ridge National Laboratory, Biology Div., Oak Ridge, Tenn.~~

2. TO: Transporation Officer, Patrick AFB, Flordia
General Electric Co. ETR, Hanger "S"
Cape Kennedy, Flordia Attn: J. R. Krepps M/F NAS 2-1900

9. AUTHORITY OR PURPOSE: J. Glancey/Hemium Agreement

11a. VOUCHER NUMBER AND DATE: CS67-19-161

12. DATE SHIPPED: 8/27/67

b. VOUCHER NUMBER AND DATE: 8/5/67

3. SHIP TO -MARK FOR: Same as above

13. MODE OF SHIPMENT: Hand carried

4. ACCOUNTING AND FUNDING DATA: 80X0108 (64) 2510 - R- 2100

ITEM NO. a	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL AND/OR SERVICES b	UNIT OF ISSUE c	QUANTITY REQUESTED d	SUPPLY ACTION e	TYPE CONTAINER f	CONTAINER NOS. g	UNIT PRICE h	TOTAL COST i
1	47D168798G1, Neurospora Module, S/N 15A	ea.	1					
2	" " " " 16	"	1					
3	" " " " 16A	"	1					
4	" " " " 17	"	1					
5	" " " " 17A	"	1					
6	" " " " 18	"	1					
7	" " " " XVII	"	1					
8	" " " " XVIII	"	1					
9	" " " " XXI	"	1					
10	" " " " XXII	"	1					
11	" " " " XXIII	"	1					
12	" " " " XXIV	"	1					
13	" " " " XXV	"	1					
14	" " " " V	"	1					
15	" " " " XVI	"	1					

16. TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO

17. SPECIAL HANDLING

RECAPITULATION OF SHIPMENT

18. ISSUED BY	TOTAL CONTAINERS	TYPE CONTAINER	DESCRIPTION	TOTAL WEIGHT	TOTAL CUBE
CHECKED BY					
PACKED BY					
		←	TOTAL		→

RECEIPT

19.	DATE	BY	
CONTAINERS RECEIVED EXCEPT AS NOTED			SHEET TOTAL
QUANTITIES RECEIVED EXCEPT AS NOTED			GRAND TOTAL
POSTED			20. RECEIVER'S VOUCHER NO.

DD FORM 1 MAR 59 1149 REPLACES EDITION OF WHICH MAY BE USED

V. FLIGHT OF BIOSATELLITE B

A. Personnel and Responsibilities

Specific responsibilities for flight or launch simulations, as well as the assignment of these responsibilities to particular people for the Biosatellite A flight, were described previously (ORNL-TM 1959). During the period between the launch dates of Biosatellite A and Biosatellite B, it became necessary to alter these assignments because of replacements or other changes in status as shown in Table 3. The major new assignment in regard to preparation for flight was the inclusion of Mrs. Miller as the third person in the assembly team; her continuing responsibility for dosimetry during the past year made her the logical choice for keeping track of the three different types of passive dosimeters which were now being used to measure the radiation exposure in each sample position. Another change was the distribution of duties in the post-flight plating and forward-mutation experiments among a larger number of personnel. This distribution, as well as the rehearsal of the responsibilities in the 201 and 301 Gantry Exercises and the forward-mutation exercise following the 201 Gantry Exercise, was an important factor in permitting the rapid completion of the plating, jug inoculation, and jug harvesting for this 180-jug experiment. Table 4 indicates the traveling and work schedules for the pre-flight and flight-readiness periods, while Table 5 presents the assignments for responsibilities during the post-flight period.

Table 3. Changes in responsibilities of personnel for the Neurospora experiment in the Biosatellite B flight

Responsibilities	Personnel	
	Biosatellite A	Biosatellite B
Principal investigator; experimenters' representative	F. J. de Serres	F. J. de Serres
Coinvestigator; Samoan contingency and communications at Hickam Field	B. B. Webber	B. B. Webber
Receipt of assemblies in recovery area; assist in preparation for Samoan contingency	I. C. Miller	A. P. Teasley
Coupling of assemblies and coverage of Hangar S laboratory	E. C. Gourley D. S. Carroll	E. C. Gourley D. S. Carroll
ORNL module preparation team	M. C. Gibson A. P. Teasley	M. T. Sheppard P. E. Harris I. C. Miller
Transport team No. 1	J. S. Wassom D. W. Ramey	J. S. Wassom S. H. Lyon
Transport team No. 2	L. Oggs L. B. Ralston	L. B. Ralston W. K. Barnett
Transport team No. 3	M. T. Sheppard P. E. Harris	D. W. Ramey M. D. Shelby
Alternates for transport	W. P. Henry	P. N. Gambill

Table 4. Schedules for pre-flight and flight-readiness periods

Revised 8/17/67	August									September																			
	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Event	301 Gantry T-O									Flight readiness T-O X X X																			
									Genetics Society																				
F. J. de Serres	Cape Kennedy								Stanford			Cape Kennedy					Honolulu (?)				Oak Ridge (?)								
B. B. Webber									Stanford			Honolulu									Oak Ridge (?)								
A. P. Teasley																Honolulu					Oak Ridge (?)								
E. C. Gourley	Cape Kennedy																				Oak Ridge (?)								
D. S. Carroll	Cape Kennedy																				Oak Ridge (?)								
J. S. Wassom (T1)			Cape Kennedy										Cape Kennedy							Cape (?)									
S. H. Lyon (T1)			Cape Kennedy										Cape Kennedy																
L. B. Ralston (T2)					Cape Kennedy										Cape Kennedy						Cape (?)								
W. K. Barnett (T2)					Cape Kennedy										Cape Kennedy						Cape (?)								
D. W. Ramey (T3)							Cape Kennedy									Cape Kennedy						Cape (?)							
M. D. Shelby (T3)							Cape Kennedy									Cape Kennedy						Cape (?)							
P. N. Gambill																			Cape (?)										
Module Preparation			*		*		*					*		*		*		(*)		(*)		(*)							
M. T. Sheppard P. E. Harris I. C. Miller																													

Table 5.

A. Responsibilities for plate counting and jug harvesting

B. Responsibilities for module disassembly and sample analysis

Coordinator: F. J. de Serres

First Alternate: B. B. Webber

Second Alternate: W. P. Henry

PERSONNEL	RESPONSIBILITIES
Plate Counts and Data Tabulation	
M. T. Sheppard — Coordinator	
A. P. Teasley P. E. Harris M. T. Sheppard	Colony counts
M. T. Sheppard (I. C. Miller)	Data tabulation
M. T. Sheppard (I. C. Miller)	Preparation of IBM data sheets
Jug Harvesting	
B. B. Webber - Coordinator	
(a) Materials	
W. P. Henry	Sterile H_2O, forceps, trays, fluorescent lamps
L. B. Ralston S. H. Lyon P. N. Gambill	Isolation medium
(b) Harvesting	
W. P. Henry	Data sheet preporation
D. S. Carroll J. S. Wassom	Pour samples - (1) measure total volume, (2) dispense 1500-ml aliquots, (3) dispense 10-ml background samples
L. B. Ralston, W. K. Barnett, D. W. Ramey, M.D. Shelby, S. H. Lyon, (E. C. Gourley), P. N. Gambill, L. Oggs	Mutant isolation
M. T. Sheppard	Background aliquots - (1) label tubes, (2) pH measurements, (3) pick up background aliquots
A. P. Teasley P. E. Harris	Mutant colony storage and subculture
E. C. Gourley (M. D. Shelby)	Jug transport from incubator
M. T. Sheppard D. S. Carroll	Background colony counts
B. B. Webber	Checkout of data sheets

PERSONNEL	RESPONSIBILITIES
Module Disassembly	
M. T. Sheppard — Coordinator	
M. T. Sheppard	Disassemble modules
P. E. Harris	Prepare suspensions from samples, make 10^{-4} dilutions
I. C. Miller	Dosimeter unloading and readout
A. P. Teasley	Hemacytometer counts
Plating Materials	
L. Oggs - Coordinator	
L. Oggs P. N. Gambill	Prepare plating medium
S. H. Lyon P. N. Gambill	Color code and label plates
D. S. Carroll E. C. Gourley	Media autoclaving and water bath control
L. B. Ralston D. W. Ramey	Sample inoculation
M. D. Shelby W. K. Barnett	Incubation of plates
Jug Materials	
W. P. Henry - Coordinator	
J. S. Wassom M. D. Shelby W. K. Barnett	Prepare jugs
M. D. Shelby W. K. Barnett	Prepare sorbose solution
D. S. Carroll J. S. Wassom	Jug inoculation (a) sorbose addition and sample inoculation
M. D. Shelby W. K. Barnett	Jug inoculation (b) jug transportation
E. C. Gourley (M. D. Shelby)	Jug inoculation (c) air-flow regulation

B. Preparation of Biological Samples for Biosatellite B

On August 25, conidia of heterokaryon No. 12 from a silica-gel stock culture were suspended in water and then streaked on the surface of Fries minimal medium solidified with agar in petri plates and incubated 2 days at 35° C. The heterokaryon consists of strain 74-OR60-29A (which contains the markers hist-2, ad-3A, ad-3B, nic-2, inos, and ad-2 and is of mating type A), and strain 74-OR31-16A (which contains the markers al-2, pan-2, and cot and is of mating type A). On minimal medium, only those conidia with at least one nucleus of each type are expected to grow. On August 27, single-colony isolates were made from these plates into flasks, on a surface of solidified minimal medium. The flasks were incubated for 2 days at 35° C, and then at room temperature (about 22-25° C) for 5 more days. Nineteen of these cultures were selected on the basis of their color (bright orange) and, on September 3, conidial harvesting was initiated by the addition of about 10 ml of sterile, cold, polished, Pyrex glass beads (3 mm diameter) to each of the culture flasks. The flasks were shaken to break up the conidial clusters as thoroughly as possible, and water (at 6° C) was added to suspend the mixture of mycelium and conidia. From this time until assembly at Cape Kennedy, the temperature of the biological samples was maintained at about 6° C. The resulting suspensions were filtered through platinum gauze to remove clumps of mycelium and then filtered six times through cotton pads to produce a morphologically uniform suspension of cells. Finally the conidia were collected on Millipore filters and washed three times with water. They were then resuspended in water and the conidial concentration was estimated from hemocytometer counts. This suspension was then diluted, and further adjusted to provide about 2000 ml of a suspension containing approximately 5×10^6 conidia/ml. The hemocytometer counts of 2×10^{-5} ml aliquots of the final suspension were 103, 89, 99, 105, 97, and 98 (with an average of 96.83). The precise estimate of the conidial concentration was therefore 4.84×10^6/ml.

C. Platings and Estimates of Conidial Viability

For estimating the viability of heterokaryotic conidia and general viability, the following procedure was used:

1. One-tenth ml of the suspension was pipetted into 9.9 ml of water to provide a 10^{-2} dilution; then a second such 0.1:9.9 dilution was made from the 10^{-2} dilution to provide a 10^{-4} dilution.
2. Two ml of the 10^{-4} dilution were plated in each of two aliquots of a minimal medium in which only the heterokaryotic conidia form colonies. One ml was plated in each of two aliquots of a supplemented medium which supports the growth of all conidia (both heterokaryotic and homokaryotic).
3. Steps 1 and 2 were repeated so that four minimal plates from two separate dilution series and four supplemented plates from the same two dilution series were prepared.
4. These plates were incubated at 30° C, the minimal plates for 3 days and the supplemented plates for 4 days, and the resulting colonies were counted. The counts were as follows:

Minimal plates	
Dilution series I	188 colonies
	189 colonies
Dilution series II	196 colonies
	199 colonies
Average	193 colonies
Supplemented plates	
Dilution series I	345 colonies
	338 colonies
Dilution series II	346 colonies
	363 colonies
Average	348 colonies

5. The estimated number of colonies/ml of original suspension were then divided by the estimated number of conidia/ml of original suspension giving 19.92% heterokaryotic viability and 71.87% general viability.

D. Preparation of Modules

The conidial suspension was maintained at ice-water temperature and kept suspended by the use of a magnetic stirring bar and stirrer. Ten-ml aliquots were harvested on individual Millipore filters (type RAWP 02500) and these were inserted with dosimeters into the module disks, which were in turn assembled to form the modules as described in the modified standing instruction (ORNL-TM 1734). The 15 modules are listed in the Requisition and Shipping Invoice (DD Form 1149) presented as Table 6. The modules listed as Item Nos. 1 through 6 are flight modules and include the five modules which were inserted into the spacecraft and one backup module. The other modules (listed as Item Nos. 7 through 15) are flight-type modules, but were to be used for the ground-control portions of the experiment. The modules were placed into their sterile stainless-steel boxes on September 4 and transported, packed in ice, to Cape Kennedy on that day. Immediately upon arrival at Cape Kennedy, the couriers (W. K. Barnett and S. H. Lyon) placed the modules in the refrigerator at Hangar S, where they were stored at about 6° C until the time for coupling the housings with the modules.

E. Activities of ORNL Personnel Before, During, and After Flight of Biosatellite B

On August 31, the Neurospora laboratory area was tested for the presence of air-borne microbial contaminants by placing nutrient agar plates just above the door to the transfer room for 1 hr. After incubation, seven yeast and/or bacterial colonies were found on each plate. This figure is near the top of the range for similar tests at ORNL. This is a low level of contamination, and these tests showed that no unusual procedures would be required in the coupling protocol to ensure sterility.

Table 6

SHIPPING CONTAINER TALLY 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

REQUISITION AND INVOICE/SHIPPING DOCUMENT

SHEET NO. 1 | NO. OF SHEETS | 5. REQUISITION DATE | 6. REQUISITION NO.

1. FROM

NAS-2-1900

~~Oak Ridge National Laboratory, Biology Div., Oak Ridge, Tenn.~~

Transportation Officer, Patrick AFB, Florida
General Electric Co. ETR-Hanger "S"
~~Cape Kennedy, Florida~~ Attn: J. R. Krepps M/F NAS 2-1900

7. DATE MATERIEL REQUIRED | 8. PRIORITY

9. AUTHORITY OR PURPOSE

~~J. Glancey/Hemlup Agreement~~

10. SIGNATURE: Ashton B. Carver | 11. SHIP VOUCHER NUMBER AND DATE: CS67-19-161

3. SHIP TO -MARK FOR

Same as above

12. DATE SHIPPED: 9/4/67 | b. VOUCHER NUMBER AND DATE: 8/5/67

13. MODE OF SHIPMENT: ~~Hand carried~~ | 14. BILL OF LADING NUMBER

15. AIR MOVEMENT DESIGNATOR OR PORT REFERENCE NUMBER

4. ACCOUNTING AND FUNDING DATA

~~80X0108 (64)m2510-R-2100~~

ITEM NO. a	FEDERAL STOCK NUMBER, DESCRIPTION, AND CODING OF MATERIEL AND/OR SERVICES b	UNIT OF ISSUE c	QUANTITY REQUESTED d	SUPPLY ACTION e	TYPE CONTAINER f	CONTAINER NOS. g	UNIT PRICE h	TOTAL COST i
1	47D168798G1, Neurospora Module, S/N 1	ea.	1					
2	" " " " 3	"	1					
3	" " " " 4	"	1					
4	" " " " 11	"	1					
5	" " " " 14A	"	1					
6	" " " " 15	"	1					
7	" " " " I	"	1					
8	" " " " III	"	1					
9	" " " " VI	"	1					
10	" " " " VIII	"	1					
11	" " " " IX	"	1					
12	" " " " X	"	1					
13	" " " " XIII	"	1					
14	" " " " XIV	"	1					
15	" " " " XV	"	1					

16. TRANSPORTATION VIA MATS OR MSTS CHARGEABLE TO

17. SPECIAL HANDLING

RECAPITULATION OF SHIPMENT

18.	TOTAL CONTAINERS	TYPE CONTAINER	DESCRIPTION	TOTAL WEIGHT	TOTAL CUBE
ISSUED BY					
CHECKED BY					
PACKED BY					
		←	TOTAL		

RECEIPT

19.	DATE	BY	
CONTAINERS RECEIVED EXCEPT AS NOTED			SHEET TOTAL
QUANTITIES RECEIVED EXCEPT AS NOTED			GRAND TOTAL
POSTED			20. RECEIVER'S VOUCHER NO.

DD FORM 1 MAR 59 REPLACES EDITION OF 1 MAY 5 ...CH MAY BE USED

On September 7, between 0227 and 0237 EDT (0637 GMT), the six flight modules (including one backup module) were coupled into flight housings previously sterilized by autoclaving. The control I and II modules (for incubation and irradiation simultaneously with flight) were coupled into flight-type housings between 0233 and 0240 EDT (0640 GMT) and the control III module and spare (for incubation commencing 3 hr after the flight modules) were coupled into housings at 0520-0521 EDT (0921 GMT). The module and housing numbers for the flight and each kind of control experiment are listed with the scheme for jug inoculations in Table 7.

The scheduled launch time was 1504 EDT (1904 GMT). Launch was delayed, however, until 1804 EDT (2204 GMT) because of (1) a required change in the installation of the gravity switch and (2) an apparent malfunction of the hydraulic system in the rocket. At this time the estimated data return for the Neurospora experiment was 100%. On September 9, when it became clear that an early call-down would be desirable because of (1) unfavorable weather conditions in the recovery area and (2) difficulties in transmitting signals effectively to the spacecraft from certain of the tracking stations, the expected data return for the Neurospora experiment was estimated at about 55%. This estimate was based on the assumption that the craft would be recovered in an air-snatch and would be returned to Hickam Field without delay. Both of these conditions were met, with air-snatch occurring at 1915 GMT and arrival at Hickam Field at about 2200 GMT.

The control I and control II modules were uncoupled and refrigerated at ice-water temperature by 2125 EDT and the control III modules were uncoupled and refrigerated by 2313 EDT. These were transported from Cape Kennedy to Oak Ridge on September 10, arriving at ORNL around 1900 EDT. The flight assemblies, with modules still coupled in housings, were refrigerated simultaneously with the control I and II modules and transported to Oak Ridge, leaving Hawaii on September 11 around 2300 HST and arriving at Oak Ridge around 1700 EDT on September 12. Uncoupling of the flight modules was not carried out until September 13 and 14 when the conidia were used in the assay system.

Table 7. Plans for inoculation of jugs with conidia from Biosotellite B experiment

Module Designation	Housing Designation	Test or Flight Position	Filter No.	Arbitrary Treatment No.	Jugs Inoculated	Date of Inoculation (September)
3	SN/9	Flight; aft (unirradiated)	2	1	1, 79, 87, 109, 125, 168	13
			9	2	9, 22, 42, 95, 113, 146	13
XIV	20	Control I; aft (unirradiated)	2	3	30, 75, 111, 129, 160, 167	13
			9	4	3, 46, 64, 91, 132, 150	13
1	SN/4	Flight; "6000 R"	1	5	24, 51, 67, 84, 112, 135, 153, 166	13
			2	6	2, 45, 71, 83, 105, 133, 157, 174	13
			4	20	20, 36, 47, 97, 101, 134, 144, 178	13
			6	7	28, 60, 61, 88, 114, 121, 154, 162	13
			9	8	18, 31, 44, 78, 82, 130, 142, 170	13
VIII	16	Control I; "6000 R"	1	9	16, 34, 52, 70, 108, 140, 151, 163	13
			2	10	4, 37, 55, 68, 86, 124, 158, 172	13
			4	25	21, 54, 80, 98, 120, 136, 147, 180	13
			6	11	13, 25, 53, 72, 96, 107, 145, 179	13
			9	12	15, 29, 41, 74, 94, 117, 128, 161	13
4	SN/2	Control II (constant temperature)	2	13	8, 62, 90, 149	14
IX	48	Control III (lapsed time, controlled temperature control)	2	14	12, 23, 106, 165	14
XV	39	Control III	2	15	11, 33, 104, 127	14
15	SN/1	Flight; "2500 R"	1	16	32, 50, 65, 93, 115, 131, 148, 173	14
			5	17	14, 35, 48, 66, 81, 103, 141, 169	14
			9	18	10, 49, 69, 92, 102, 138, 156, 175	14
14	SN/3	Flight; "1000 R"	1	19	17, 26, 59, 85, 118, 123, 159, 177	14
VI	17	Control I; "2500 R"	1	21	19, 39, 58, 63, 116, 122, 155, 176	14
			5	22	6, 40, 57, 73, 89, 137, 143, 171	14
			9	23	7, 27, 56, 76, 100, 110, 139, 164	14
X	18	Control I; "1000 R"	1	24	5, 38, 43, 77, 99, 119, 126, 152	14
11	SN/8	Flight; "500 R"	Conidia not used in analysis			
III	19	Control I; "500 R"				
I	35	Control II				
XIII	37	Control II				

F. Temperature Profile During the Flight

After being coupled, the Neurospora assemblies were kept at about 70-72° F in the laboratory until the scheduled interface. During the flight, telemetered data indicated that the assemblies in the fore compartment were maintained at a temperature range of 67-69° F, while assemblies in the fore compartment of the control I vehicle were kept at about 69° F. The aft (unirradiated) assembly in the flight experienced a temperature range of 64-66° F, which was 6 to 8 Fahrenheit degrees lower than the 72° F registered by the control I aft assembly during most of the flight period.

G. Completion of Preliminary Portions of the Assay

The flight material arrived at ORNL on September 12 and, as previously scheduled, the conidial platings and jug inoculations were completed on September 13 and 14. The scheme for plating and jug inoculations is presented in Table 7; this also indicates the function of each of the 15 modules in the set used for flight. The plans were prepared with the idea that approximately half of the jugs should be inoculated on September 13 and harvested on September 19, and the other half inoculated on September 14 and harvested on September 20, leaving September 21 to finish any remaining jugs. It was considered desirable to use all of the filters selected from a given assembly on the same day, and to open both a given flight package and its corresponding control package from the control I vehicle on the same day. Late in the day on September 13 it was decided to include an additional filter (No. 4 filter) from each of the "6000-R" assemblies in the analysis (treatments 20 and 25) and so these were also inoculated on September 13. The conidia receiving the highest gamma-radiation exposures in both the flight vehicle and the ground control vehicle (contol I) as well as unirradiated conidia from the flight and control I vehicles were introduced into the assay system for both plating and jug inoculation on September 13. On September 14 controlled-temperature, unirradiated control assemblies (controls II and III) and irradiated conidia which would occupy lower points in the dose-response curve and would provide fewer purple mutants

for analysis were processed. All plates were incubated at 30° C. The minimal and pantothenate-supplemented plates were incubated for 3 days and then stored at 4-10° C; the other plates were chilled and stored at 4-10° C after 4 days of growth. The colonies on all plates were counted on September 18 and on that day random colonies were picked from selected plates for the assay of recessive lethal mutations in adenine-independent heterokaryotic conidia. The jugs were incubated in the dark with bubbling and then harvested on September 19-21. The subculturing of all purple colonies obtained from the jugs was also completed by September 21. The genetic characterization of the purple mutants was begun soon after the jug harvesting was completed, but this is expected to require at least 6 months for completion. The analysis of the jug and plating data will be presented in a later quarterly report.

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SECTION 2

BIOLOGY DIVISION

NEUROSPORA EXPERIMENT P-1037

QUARTERLY PROGRESS REPORT

TO THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OCTOBER 1 — DECEMBER 31, 1967

(Printed separately as ORNL-TM-2310)

ORNL-TM-2310

BIOLOGY DIVISION

QUARTERLY PROGRESS REPORT
TO THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

October 1 - December 31, 1967

NOVEMBER 1968

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

QUARTERLY PROGRESS REPORT
TO THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Title of Project:

Mutagenic Effectiveness of Known Doses of Gamma Irradiation in Combination with Zero Gravity on Neurospora

For the Period:

October 1 - December 31, 1967

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Interagency Agreement:

Purchase Order R-104, Task No. 8

Experiment Proposal No.:

P-1037

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I. INTRODUCTION

The quarterly reports ORNL-TM-1734, ORNL-TM-1959, ORNL-TM-2189, ORNL-TM-2190, and ORNL-TM-2235 provide background information for the data in the present report. ORNL-TM-1734 describes the results of early experiments in the laboratory designed to estimate dose-response curves for the induction of mutations in the ad-3 region and for nuclear inactivation in heterokaryotic conidia, and of experiments designed to assess the possible effects of anoxia during irradiation. The development of the Neurospora housing and modules for use in the Biosatellite experimentation is described, and the results of biological assays with conidia used in the qualification and acceptance tests of the hardware at the General Electric Company facility are also presented in that report. ORNL-TM-1959 describes tests, launch simulations, and gantry exercises at Cape Kennedy in preparation for the Biosatellite I flight, as well as plans and personnel deployment procedures for the Biosatellite I flight. ORNL-TM-2189 describes some of the activities at the time of preparation for the Biosatellite I flight and presents data and an analysis of data derived from conidia irradiated in the ground-control portion of that experiment. Some of the input and output sheets for the electronic data-processing system are also included and described in that report. ORNL-TM-2190 was concerned strictly with dosimetry and described the Con-Rad passive dosimetry system upon which we had been relying and some of the sources of variation and problems associated with the use of this system. ORNL-TM-2235 describes briefly the two gantry exercises immediately preceding the Biosatellite II flight. It also contains a description of ORNL personnel activities during the preparation of material for the Biosatellite II flight and during the flight itself. The experimental plan and the selection of conidia from both the flight and ground-control samples for assays of nuclear inactivation and forward mutation are also described.

In the present report, the data from the Biosatellite II experiment are presented, along with the genetic analysis and tentative conclusions. Much of the presentation will be in the form of data input sheets, or IBM machine print-outs reproducing the same information, and of data print-outs indicating the steps in the regression analyses used to estimate and compare the dose-response curves for various genetic effects measured in the flight and ground-control samples.

II. PASSIVE DOSIMETRY FOR THE NEUROSPORA ASSEMBLIES IN THE BIOSATELLITE II FLIGHT

In the Neurospora assemblies, each conidial sample was positioned immediately adjacent to one of each of the three different types of passive dosimeters for measuring ionizing radiation, namely (1) E. G. & G. CaF_2 half-mini dosimeters, (2) E. G. & G. LiF half-mini dosimeters, and (3) Con-Rad LiF teflon-disk dosimeters. The discussion of techniques and correction factors required to obtain a valid estimate of ionizing radiation exposure with each of these types of dosimeters will be presented in a subsequent report.

The estimate of the exposure in Roentgens to each of the dosimeters in the flight and ground-control vehicles is presented in Table 1. The plots of the logarithm of exposure against logarithm of distance between dosimeter and radiation source are presented in Fig. 1 for the dosimeters in the flight vehicle and in Fig. 2 for the ground-control vehicle. In Table 2, parameters for regression lines fitted to data for each of the three types of dosimeters are presented; the necessary computations are made for the two vehicles separately as well as combined. Since the individual slopes and intercepts are not different from one another and not different from the slope and intercept of a regression line fitted to all 239 points, the estimates based on 239 points are used as the best estimates for the gamma radiation exposures. In Table 3, the gamma radiation exposures from this last regression line for each of the filter positions are listed, and the radiation exposures received by the biological samples on each of the filters used in the genetic analysis are marked with asterisks in that table.

Table 1. Gamma radiation exposure (Roentgens) to each of the dosimeters in irradiated Neurospora housings in the Biosatellite II flight and ground-control vehicles

Housing Position	Filter No.	Distance Between Dosimeter and Radiation Source (cm)	Dosimeters from Flight Vehicle			Dosimeters from Ground-Control Vehicle		
			E.G. & G. CaF_2	E.G. & G. LiF	Con-Rad LiF	E.G. & G. CaF_2	E.G. & G. LiF	Con-Rad
"6000 R"	1	6.12	3367	3443	2875	3236	3387	3250
	2	6.43	2871	3044	2875	2839	2564	2850
	3	6.74	2655	2527	2550	2689	2796	2550
	4	7.05	2492	2515	2300	2391	2150	2375
	5	7.36	2176	2372	2025	2273	2199	2225
	6	7.67	1994	2074	2000	2145	2192	2175
	7	7.98	1796	1641	1725	1978	1799	1950
	8	8.29	1637	1756	1625	1765	1860	1775
	9	8.60	1465	1555	1675	1618	1681	1700
	10	8.91	1477	1367	1425	1441	1406	1625
"2500 R"	1	9.67	1245	1543	1600	1327	1639	1450
	2	9.98	1104	1397	1375	1234	1173	1375
	3	10.29	1132	1363	1275	1171		1275
	4	10.60	1063	1191	1250	1082	1209	1225
	5	10.91	1036	1358	1250	995	1067	1175
	6	11.22	1240	1127	1150	967	940	1025
	7	11.53	911	977	1025	830	1008	1025
	8	11.84	810	981	1000	829	966	1025
	9	12.15	847	1048	990	819	991	970
	10	12.46	764	904	900	711	928	875
"1000 R"	1	15.10	572	632	660	555	632	610
	2	15.41	509	618	575	570	586	575
	3	15.72	545	623	550	554	595	550
	4	16.03	511	516	540	490	542	525
	5	16.34	500	543	540	489	527	530
	6	16.65	499	619	480	487	482	510
	7	16.96	463	526	470	483	539	480
	8	17.27	456	522	460	480	509	480
	9	17.58	397	514	435	446	457	470
	10	17.89	411	471	405	431	433	450
"500 R"	1	20.94	305	352	315	305	289	345
	2	21.25	282	326	325	323	339	310
	3	21.56	307	334	315	306	307	310
	4	21.87	273	313	290	295	301	300
	5	22.18	304	268	300	298	286	300
	6	22.49	258	314	280	278	287	285
	7	22.80	242	313	265	283	310	285
	8	23.11	267	294	265	275	263	270
	9	23.42	255	252	270	264	261	265
	10	23.73	246	253	255	247	244	265

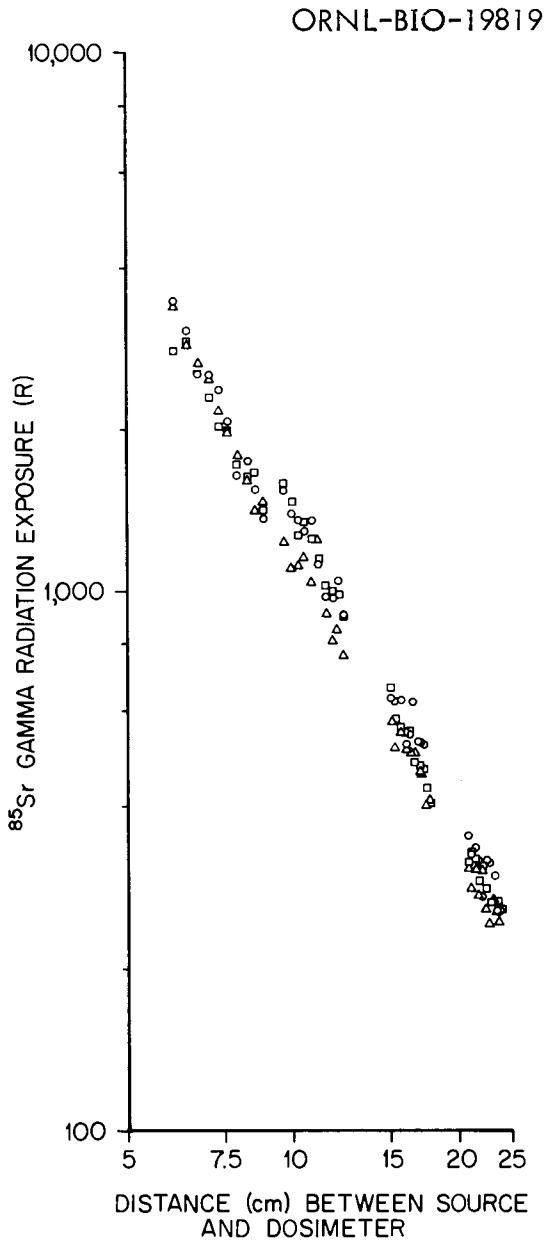

Fig. 1. Radiation Exposure for Flight Vehicle Dosimeters

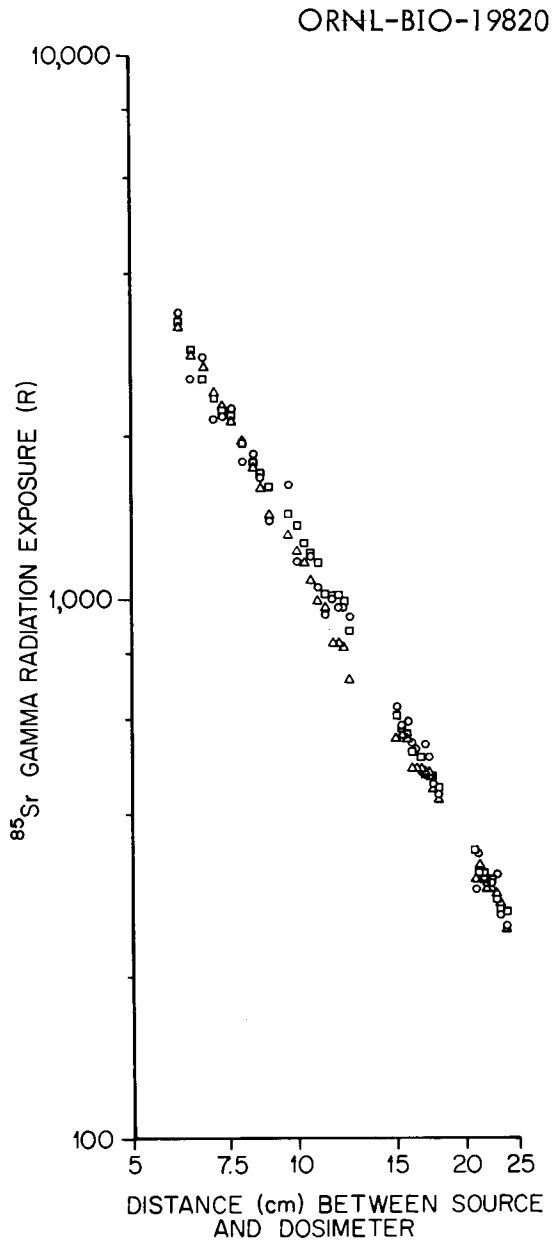

Fig. 2. Radiation Exposure for Ground-Control Vehicle Dosimeters

Logarithm of gamma radiation exposure to each of the dosimeters in the flight vehicle plotted against logarithm of distance (cm) separating each dosimeter from the radiation source. (O = E.G. & G. LiF dosimeters; Δ = E.G. & G. CaF_2 dosimeters; □ = Con-Rad disk dosimeters.

Table 2. Regression coefficient estimates, based on the series of dosimeters indicated below, for logarithm of gamma radiation exposure plotted against logarithm of distance (cm) separating dosimeters from radiation source

Type and Location of Dosimeter	N	Sum of Y	Mean of Y	Sum of X	Mean of X	Slope	Variance of slope ($\times 10^{-4}$)	Intercept	Variance of Intercept ($\times 10^{-3}$)	Residual Variance ($\times 10^{-3}$)
Con-Rad Lithium Fluoride Disk										
1. Flight vehicle	40	265.736	6.64339	103.173	2.57932	-1.82977	6.78723	11.3629	4.63557	4.80414
2. Ground-control vehicle	40	266.469	6.66173	103.173	2.57932	-1.84917	1.52220	11.4314	1.03964	1.07745
3. Flight and ground-control vehicles	80	532.205	6.65256	206.346	2.57932	-1.83947	2.09878	11.3971	1.43343	2.97112
E.G. & G. CaF_2										
1. Flight vehicle	40	263.546	6.58864	103.201	2.58003	-1.86461	6.23904	11.3994	1.43343	4.43507
2. Ground-control vehicle	40	264.379	6.60873	103.173	2.57932	-1.84045	3.64385	11.3558	2.48869	2.57919
3. Flight and ground-control vehicles	80	527.895	6.59869	206.374	2.57968	-1.85257	2.49213	11.3777	1.70264	3.53553
E.G. & G. LiF										
1. Flight vehicle	40	267.583	6.68958	103.173	2.57932	-1.80844	9.96620	11.3541	6.80676	7.05429
2. Ground-control vehicle	39	258.86	6.66384	100.842	2.58568	-1.83028	7.66959	11.37	5.26565	6.51214
3. Flight and ground-control vehicles	79	526.444	6.66384	204.014	2.58246	-1.81967	4.62049	11.3631	3.16388	6.51214
All Three Types of Dosimeters on Flight and Ground-Control Vehicles	239	1586.54	6.63826	616.734	2.58048	-1.83712	1.22594	11.3789	0.838108	5.20265

Table 3. Estimated gamma radiation exposures based on regression curve fitted to combined data (239 pairs of data) for all three types of dosimeters in both flight and ground-control vehicles

Neurospora Assembly Position	Filter Position No.	Distance Between Dosimeter and Radiation Source (cm)	Estimated Gamma Radiation Exposure (roentgens)
"6000 R"	1	6.12	3136.43*
	2	6.43	2864.26*
	3	6.74	2626.91
	4	7.05	2418.62*
	5	7.36	2234.78
	6	7.67	2071.66*
	7	7.98	1926.22
	8	8.29	1795.97
	9	8.6	1678.83*
	10	8.91	1573.09
"2500 R"	1	9.67	1353.46*
	2	9.98	1277.24
	3	10.29	1207.44
	4	10.6	1143.36
	5	10.91	1084.39*
	6	11.22	1029.99
	7	11.53	979.684
	8	11.84	933.078
	9	12.15	889.81*
	10	12.46	849.564
"1000 R"	1	15.1	596.86*
	2	15.41	574.988
	3	15.72	554.329
	4	16.03	534.795
	5	16.34	516.303
	6	16.65	498.781
	7	16.96	482.161
	8	17.27	466.38
	9	17.58	451.383
	10	17.89	437.119
"500 R"	1	20.94	327.342
	2	21.25	318.623
	3	21.56	310.257
	4	21.87	302.226
	5	22.18	294.511
	6	22.49	287.097
	7	22.8	279.966
	8	23.11	273.106
	9	23.42	266.502
	10	23.73	260.141

*Exposures for samples on filters used in the genetic analysis.

III. DATA FROM CONIDIAL PLATINGS

As described previously (in ORNL-TM-2235), conidial samples receiving the exposures indicated by asterisks in Table 3 as well as unirradiated ground-control and flight conidia were selected for genetic analysis. Each filter with its sample of 5×10^7 conidia was soaked in 10 ml of cold sterile 1/15 M phosphate buffer (KH_2PO_4 and Na_2HPO_4) at pH 7.0 to provide a suspension of about 5×10^6 conidia/ml. The estimate of conidial concentration for each suspension is based on the hemocytometer counts which are collected on No. 80211 data sheets. Each of the six counts for each suspension represents 2×10^{-5} ml of suspension (with the exception of treatment #24, for which the conidial sample was suspended accidentally in 20 ml of buffer and so six counts of 4×10^{-5} ml were used). The hemocytometer counts are used in the estimates of survival for the jug data as well as for the plating data.

Hemocytometer Count After Resuspending the Conidia from Millipore Filters

DECK NUMBER 6-8 Wild Type: 012; 9-11 Experiment: 073

CARD NUMBER 80211

Treatment 12-14	Dilution 15-18	Counted 19-20	Basic Unit 21-22	Technician 23-24	No. Units 25-26	Count 27-30	No. Units 31-32	Count 33-36	No. Units 37-38	Count 39-42	No. Units 43-44	Count 45-48
001	00000	0	13	01	05	0086	05	0083	05	0081	05	0080
001						0082		0081				
002						0074		0084		0098		0092
002						0087		0084				
003						0097		0094		0100		0093
003						0093		0102				
004						0090		0081		0079		0089
004						0095		0079		0085		0086
005						0091		0085		0084		0085
005						0091		0096				
006						0091		0073		0079		0075
006						0084		0085				

Hemocytometer Count After Resuspending the Conidia from Millipore Filters (continued)

DECK NUMBER 6-8 Wild Type: 012; 9-11 Experiment: 073

CARD NUMBER 80211

Treatment 12-14	Dilution Counted 15-19	Basic Unit 21-22	Technician 23-24	No. Units 25-26	Count 27-30	No. Units 31-32	Count 33-36	No. Units 37-38	Count 39-42	No. Units 43-44	Count 45-48
007	00000	13	01	05	0081	05	0086	05	0081	05	0088
007					0077		0080				
008					0107		0083		0087		0087
008					0090		0085				
009					0087		0078		0072		0086
009					0083		0085				
010					0074		0079		0084		0092
010					0080		0092				
011	00000	13	01	05	0084	05	0083	05	0079	05	0085
011					0089		0086				
012					0077		0085		0087		0091
012					0081		0098				
013					0072		0085		0072		0090
013					0084		0095				
014					0092		0100		0084		0089
014					0106		0074				
015					0094		0061		0083		0074
015					0088		0075				
016					0092		0098		0089		0075
016					0088		0103				
017					0080		0086		0092		0075
017					0104		0093				
018					0086		0088		0094		0072
018					0103		0077				
019					0090		0082		0072		0072
019					0085		0081				
020					0085		0091		0099		0106
020					0091		0085				

Hemocytometer Count After Resuspending the Conidia from Millipore Filters (continued)

DECK NUMBER

6-8	9-11
Wild Type	Experiment
012	073

CARD NUMBER 80211

Treatment 12-14	Dilution Counted 15-18	19-20	Basic Unit 21-22	Technician 23-24	No. Units 25-26	Count 27-30	No. Units 31-32	Count 33-36	No. Units 37-38	Count 39-42	No. Units 43-44	Count 45-48
021	000000		13	01	05	0085	05	0092	05	0080	05	0083
021						0072		0066				
022						0076		0076		0080		0073
022						0067		0091				
023						0079		0077		0091		0074
023						0087		0076				
024					10	0074	10	0085	10	0075	10	0079
024					10	0082	10	0077				
025					05	0092	05	0100	05	0081	05	0091
025					05	0076	05	0076				

The plating procedure is described in some detail in ORNL-TM-2189. In brief, one- or two-ml aliquots of 10^{-4} dilutions of each original conidial suspension were plated in each of four different selective media and incubated until the surviving conidia of the type selected formed colonies, which were then counted. The colony counts were collected on No. 80220 data sheets (pp. 11-14). From the colony counts and hemocytometer counts, it is possible to estimate the incidence of surviving conidia of different classes; the estimates for the Biosatellite II experiment are presented in the form of print-outs (pp. 15-26). The estimates of surviving proportions of different classes of conidia are plotted: these include (1) heterokaryotic conidia (Fig. 3; see p. 27); (2) homokaryotic for component 1 (Fig. 4, p. 27); (3) homokaryotic for component 2 (Fig. 5, p. 28); (4) total survivors, i.e., those capable of growing in a medium supplemented with histidine, adenine, nicotinamide, inositol, and pantothenic acid (Fig. 6, p. 28). Since the survival of the unirradiated ground-control and unirradiated flight conidia do not differ for any of the four classes of conidia, all data on unirradiated conidia were used to obtain an estimate of 100% survival; two platings of seven different suspensions on each of four different media are used to obtain these estimates.

Because both the total gamma radiation exposures and the exposure rates were so low, no appreciable nuclear inactivation was expected. If nuclear inactivation had occurred, the effect would have been a logarithmic decrease in the proportion of heterokaryotic conidia; at low doses, conversion of heterokaryotic conidia to homokaryotic conidia by the inactivation of one or the other of the types of nuclei present causes an increase in homokaryotic conidia; and, at much higher doses, a decrease as the remaining nuclei are also inactivated. The curve for total survival (conidia capable of forming colonies on completely supplemented media) should have a shoulder and then curve downward. On the basis of previous experiments with low doses and low dose rates, the finding (Figs. 3-6) of no appreciable effect of gamma radiation on conidial survival is not surprising. There is no apparent difference between flight and ground-control samples in this regard.

HETEROKARYON
PLATE COUNTS

Wild Type (6-8): 012

Experiment (9-11): 073

Deck Number (1-3): 802

Card Number (4-5): 20

12-13 Technician	14-16 Exp. No.	58-60 Design	17-19 Treatment	20-21 Replic.	22-23 No. of Plates	24-27 Dilution Factor (0000.)	28-29 Exp. of Dil. Factor	30-33 Factor for Percent Survival (0.000)	34-35 Min. Sub. I ml Plat. (0.0)	36-39 Min. Sub. I Col. Counted	40-41 Comp. (I) Sub. II ml Plat. (0.0)	42-45 Comp. (I) Sub. II Col. Counted	46-47 Comp. (II) Sub. III ml Plat. (0.0)	48-51 Comp. (II) Sub. III Col. Counted	52-53 Comp. Sub. IV ml Plat. (0.0)	54-57 Comp. Sub. IV Col. Counted
01		001	001	A	01	0001	04		20	0153	20	0308	10	0205	10	0259
			001	B						0144		0347		0208		0292
			002	A						0152		0328		0190		0235
			002	B						0143		0353		0165		0252
		002	003	A						0168		0354		0201		0267
			003	B						0156		0322		0169		0274
			004	A						0140		0303		0203		0262
			004	B						0150		0335		0199		0272
		001	005	A						0152		0383		0212		0283
			005	B						0131		0353		0219		0294
			006	A						0122		0317		0159		0240
			006	B						0139		0309		0166		0265
			007	A						0139		0395		0214		0254
			007	B						0118		0347		0238		0292
			008	A						0109		0347		0206		0280

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(3 5-68)

HETEROKARYON
PLATE COUNTS

Wild Type (6-8): 012

Experiment (9-11): 073

Deck Number (1-3): 802

Card Number (4-5): 20

12-13 Technician	14-16 Exp. No.	58-60 Design	17-19 Treatment	20-21 Replic.	22-23 No. of Plates	24-27 Dilution Factor (0000.)	28-29 Exp. of Dil. Factor	30-33 Factor for Percent Survival (0.000)	34-35 Min. Sub. I ml Plat. (0.0)	36-39 Min. Sub. I Col. Counted	40-41 Comp. (I) Sub. II ml Plat. (0.0)	42-45 Comp. (I) Sub. II Col. Counted	46-47 Comp. (II) Sub. III ml Plat. (0.0)	48-51 Comp. (II) Sub. III Col. Counted	52-53 Comp. Sub. IV ml Plat. (0.0)	54-57 Comp. Sub. IV Col. Counted
01		001	008	B	01	0001	04		20	0128	20	0380	10	0201	10	0281
		002	009	A						0125		0349		0169		0236
			009	B						0129		0356		0205		0236
			010	A						0119		0282		0183		0245
			010	B						0115		0305		0164		0236
			011	A						0136		0333		0200		0259
			011	B						0109		0293		0178		0256
			012	A						0118		0339		0192		0267
			012	B						0122		0337		0195		0243
			013	A						0149		0305		0183		0225
			013	B						0128		0338		0192		0276
			014	A						0151		0368		0232		0280
			014	B						0167		0355		0199		0283
			015	A						0150		0332		0199		0295
			015	B						0137		0307		0201		0244

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(3 5-68)

HETEROKARYON
PLATE COUNTS

Wild Type (6-8): 012

Experiment (9-11): 073

Deck Number (1-3): 802

Card Number (4-5): 20

12-13 Technician	14-16 Exp. No.	58-60 Design	17-19 Treatment	20-21 Replic.	22-23 No. of Plates	24-27 Dilution Factor (0000.)	28-29 Exp. of Dil. Factor	30-33 Factor for Percent Survival (0.000)	34-35 Min. Sub. I ml Plat. (0.0)	36-39 Min. Sub. I Col. Counted	40-41 Comp. (I) Sub. II ml Plat. (0.0)	42-45 Comp. (I) Sub. II Col. Counted	46-47 Comp. (II) Sub. III ml Plat. (0.0)	48-51 Comp. (II) Sub. III Col. Counted	52-53 Comp. Sub. IV ml Plat. (0.0)	54-57 Comp. Sub. IV Col. Counted
01		001	016	A	01	0001	04		20	0085	20	0309	10	0188	10	0296
			016	B						0092		0348		0193		0272
			017	A						0095		0322		0192		0247
			017	B						0113		0325		0196		0268
			018	A						0086		0323		0174		0268
			018	B						0127		0363		0193		0303
			019	A						0087		0304		0204		0253
			019	B						0100		0267		0176		0218
			020	A						0145		0327		0180		0269
			020	B						0133		0333		0188		0264
		002	021	A						0078		0304		0184		0268
			021	B						0099		0289		0200		0276
			022	A						0103		0313		0169		0247
			022	B						0130		0278		0184		0249
			023	A						0098		0309		0182		0241

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(3 5-68)

HETEROKARYON
PLATE COUNTS

Wild Type (6-8): 012

Experiment (9-11): 073

Deck Number (1-3): 802

Card Number (4-5): 20

12-13 Technician	14-16 Exp. No.	58-60 Design	17-19 Treatment	20-21 Replic.	22-23 No. of Plates	24-27 Dilution Factor (0000.)	28-29 Exp. of Dil. Factor	30-33 Factor for Percent Survival (0.000)	34-35 Min. Sub. I ml Plat. (0.0)	36-39 Min. Sub. I Col. Counted	40-41 Comp. (I) Sub. II ml Plat. (0.0)	42-45 Comp. (I) Sub. II Col. Counted	46-47 Comp. (II) Sub. III ml Plat. (0.0)	48-51 Comp. (II) Sub. III Col. Counted	52-53 Comp. Sub. IV ml Plat. (0.0)	54-57 Comp. Sub. IV Col. Counted
01		002	023	B	01	0001	04		20	0094	20	0314	10	0168	10	0266
			024	A		0005	03			0109		0287		0174		0265
			024	B		0005	03			0121		0315		0173		0275
			025	A		0001	04			0113		0320		0163		0234
			025	B		0001	04			0136		0341		0179		0271

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EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAE+LIE+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
1	A	29.54	63.04	18.62	18.86	31.28	29.92	49.61	FLT AFT NON-IRRAD CONTROL FILTER 2
1	B	24.66	71.08	17.53	24.85	33.10	35.10	46.58	FLT AFT NON-IRRAD CONTROL FILTER 2
2	A	32.34	54.34	17.57	20.25	26.36	37.45	48.51	FLT AFT NON-IRRAD CONTROL FILTER 9
2	B	28.37	58.27	16.53	24.28	21.62	41.67	37.10	FLT AFT NON-IRRAD CONTROL FILTER 9
3	A	31.46	55.34	17.41	19.27	24.25	34.83	43.82	GND AFT CONTROL GND VEHICLE FILTER 2
3	B	28.47	56.79	16.17	17.20	18.86	30.29	33.21	GND AFT CONTROL GND VEHICLE FILTER 2
15	A	25.42	74.53	18.05	22.99	31.33	30.85	42.03	GND BOX CONTROL AFT TEMP FILTER 2
15	B	28.07	61.64	17.31	21.47	33.47	36.84	54.30	GND BOX CONTROL AFT TEMP FILTER 2
14	A	26.96	61.37	16.55	23.78	34.30	38.75	55.89	GND BOX CONTROL FORE TEMP FILTER 2
14	B	29.51	62.03	18.30	20.60	25.32	33.22	40.81	GND BOX CONTROL FORE TEMP FILTER 2
13	A	33.11	54.22	17.95	18.80	26.14	34.67	48.22	GND BOX CONTROL CONSTANT TEMP FILTER 2
13	B	23.19	66.51	15.42	25.30	30.84	38.04	46.38	GND BOX CONTROL CONSTANT TEMP FILTER 2
4	A	26.72	61.29	16.37	19.06	31.11	31.11	50.76	GND AFT CONTROL GND VEHICLE FILTER 9
4	B	27.57	63.63	17.54	21.64	29.01	34.01	45.59	GND AFT CONTROL GND VEHICLE FILTER 9

DOSE 0.0

HET SURVIVAL 100.00

TOTAL SURVIVAL 100.00

COMP 1 SURVIVAL 100.00

COMP 2 SURVIVAL 100.00

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAE+LIE+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
24 A	20.57	67.37	13.86	22.63	30.38	33.58	45.09	GND 1000 R PACKAGE FILTER 1
24 B	22.00	69.92	15.38	24.66	28.60	35.27	40.91	GND 1000 R PACKAGE FILTER 1

DOSE 597.

HET SURVIVAL 94.49

TOTAL SURVIVAL 111.22

COMP 1 SURVIVAL 110.87

COMP 2 SURVIVAL 104.00

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAE+LIE+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
21 A	14.55	67.28	9.79	28.37	36.40	42.16	54.10	GND 2500 R PACKAGE FILTER 1
21 B	17.93	69.29	12.43	23.85	37.78	34.42	54.53	GND 2500 R PACKAGE FILTER 1

DOSE 1353.

HET SURVIVAL 64.21

TOTAL SURVIVAL 110.66

COMP 1 SURVIVAL 122.43

COMP 2 SURVIVAL 130.81

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
22	A	20.85	64.02	13.35	27.21	30.45	42.51	47.57	GND 2500 R PACKAGE FILTER 5
22	B	26.10	64.54	16.85	19.18	30.84	29.72	47.79	GND 2500 R PACKAGE FILTER 5

DOSE 1084.

HET SURVIVAL 87.26

TOTAL SURVIVAL 104.15

COMP 1 SURVIVAL 108.77

COMP 2 SURVIVAL 108.08

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
23	A	20.33	53.75	12.15	26.16	32.98	43.78	55.19	GND 2500 R PACKAGE FILTER 9
23	B	17.67	65.95	11.65	27.27	30.00	41.35	45.49	GND 2500 R PACKAGE FILTER 9

DOSE 820.

HET SURVIVAL 68.79

TOTAL SURVIVAL 101.84

COMP 1 SURVIVAL 125.27

COMP 2 SURVIVAL 111.04

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAE+LIE+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
9 A	26.48	57.68	15.27	27.37	26.03	47.46	45.13	GND 6000 R PACKAGE FILTER 1
9 B	27.33	57.68	15.76	27.74	34.34	48.09	59.53	GND 6000 R PACKAGE FILTER 1

DOSE 3136.

HET SURVIVAL 89.70

TOTAL SURVIVAL 93.46

COMP 1 SURVIVAL 129.22

COMP 2 SURVIVAL 106.44

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAE+LIE+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
10 A	24.29	58.69	14.25	19.52	29.58	33.27	50.41	GND 6000 R PACKAGE FILTER 2
10 B	24.36	56.53	13.77	22.75	25.51	40.25	45.13	GND 6000 R PACKAGE FILTER 2

DOSE 2864.

HET SURVIVAL 80.99

TOTAL SURVIVAL 93.34

COMP 1 SURVIVAL [illegible]

COMP 2 SURVIVAL 27.14

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
25 A	24.15	54.42	13.14	24.07	24.77	44.23	45.51	GND 6000 R PACKAGE FILTER 4
25 B	25.09	63.02	15.81	23.84	25.81	37.82	40.96	GND 6000 R PACKAGE FILTER 4

DOSE 2419.

HET SURVIVAL 83.67

TOTAL SURVIVAL 95.14

COMP 1 SURVIVAL 112.32

COMP 2 SURVIVAL 99.19

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
11 A	26.25	61.42	16.13	23.36	31.30	38.03	50.97	GND 6000 R PACKAGE FILTER 6
11 B	21.29	60.71	12.92	21.82	29.29	35.94	48.24	GND 6000 R PACKAGE FILTER 6

DOSE 2072.

HET SURVIVAL 83.96

TOTAL SURVIVAL 98.95

COMP 1 SURVIVAL 105.92

COMP 2 SURVIVAL 106.84

EXPERIMENT 73 BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
12 A	22.10	61.73	13.64	25.55	30.75	41.39	49.81	GND 6000 R PACKAGE FILTER 9
12 B	25.10	56.18	14.10	24.86	30.98	44.24	55.14	GND 6000 R PACKAGE FILTER 9

DOSE 1679.

HET SURVIVAL 80.18

TOTAL SURVIVAL 95.53

COMP 1 SURVIVAL 118.18

COMP 2 SURVIVAL 108.85

EXPERIMENT 73 BIOSATELLITE FLIGHT CAE+LIF+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
3	A	31.46	55.34	17.41	19.27	24.25	34.83	43.82	GND AFT CONTROL GND VEHICLE FILTER 2
3	B	28.47	56.79	16.17	17.20	19.86	30.29	33.21	GND AFT CONTROL GND VEHICLE FILTER 2
15	A	25.42	74.53	18.95	22.99	31.33	30.85	42.03	GND BOX CONTROL AFT TEMP FILTER 2
15	B	28.07	61.64	17.31	21.47	33.47	34.84	54.30	GND BOX CONTROL AFT TEMP FILTER 2
14	A	26.96	61.37	16.55	23.78	24.30	38.75	55.89	GND BOX CONTROL FORE TEMP FILTER 2
14	B	29.51	62.02	18.30	20.60	25.32	33.22	40.81	GND BOX CONTROL FORE TEMP FILTER 2
13	A	23.11	54.22	17.95	18.80	26.14	34.67	48.22	GND BOX CONTROL CONSTANT TEMP FILTER 2
13	B	23.19	66.51	15.42	25.30	30.84	38.04	46.38	GND BOX CONTROL CONSTANT TEMP FILTER 2
4	A	26.72	61.29	16.37	19.06	31.11	31.11	50.76	GND AFT CONTROL GND VEHICLE FILTER 9
4	B	27.57	63.63	17.54	21.64	29.01	34.01	45.59	GND AFT CONTROL GND VEHICLE FILTER 9
1	A	29.54	63.04	18.62	18.86	31.28	29.92	49.61	FLT AFT NON-IRRAD CONTROL FILTER 2
1	B	24.66	71.08	17.53	24.95	33.10	35.10	46.58	FLT AFT NON-IRRAD CONTROL FILTER 2
2	A	32.34	54.34	17.57	20.35	26.36	37.45	48.51	FLT AFT NON-IRRAD CONTROL FILTER 9
2	B	28.37	58.27	16.53	24.28	21.62	41.67	37.10	FLT AFT NON-IRRAD CONTROL FILTER 9

DOSE 0.0

HET SURVIVAL 100.00

TOTAL SURVIVAL 100.00

COMP 1 SURVIVAL 100.00

COMP 2 SURVIVAL 100.00

EXPERIMENT 73 BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
19 A	17.19	62.99	10.83	27.01	39.96	42.89	63.44	FLT 1000 R PACKAGE FILTER 1
19 B	22.94	54.27	12.45	20.79	31.37	38.30	57.80	FLT 1000 R PACKAGE FILTER 1

DOSE 597.

HET SURVIVAL 67.27

TOTAL SURVIVAL 95.00

COMP 1 SURVIVAL 112.07

COMP 2 SURVIVAL 125.77

EXPERIMENT 73 BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
16 A	14.36	65.17	9.36	24.66	32.04	37.84	49.16	FLT 2500 R PACKAGE FILTER 1
16 B	16.91	50.80	10.13	28.19	32.37	47.06	54.04	FLT 2500 R PACKAGE FILTER 1

DOSE 1353.

HET SURVIVAL 56.31

TOTAL SURVIVAL 101.32

COMP 1 SURVIVAL 123.90

COMP 2 SURVIVAL 113.56

EXPERIMENT 73 BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
17	A	19.23	55.92	10.75	25.70	32.72	45.95	58.50	FLT 2500 R PACKAGE FILTER 5
17	B	21.08	60.68	12.79	24.00	31.58	39.55	52.05	FLT 2500 R PACKAGE FILTER 5

DOSE 1084.

HET SURVIVAL 68.05

TOTAL SURVIVAL 94.47

COMP 1 SURVIVAL 116.52

COMP 2 SURVIVAL 113.38

EXPERIMENT 73 BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
18	A	16.04	61.85	9.92	27.35	30.23	44.22	48.88	FLT 2500 R PACKAGE FILTER 9
18	B	20.96	69.92	14.65	27.23	29.88	38.94	42.74	FLT 2500 R PACKAGE FILTER 9

DOSE 890.

HET SURVIVAL 71.03

TOTAL SURVIVAL 106.75

COMP 1 SURVIVAL 127.96

COMP 2 SURVIVAL 106.00

EXPERIMENT 73 BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2		
5 A	26.86	63.83	17.14	26.05	30.68	40.81	48.06	FLT 6000 R PACKAGE	FILTER 1
5 B	22.28	66.32	14.77	25.04	34.62	37.76	52.21	FLT 6000 R PACKAGE	FILTER 1

DOSE 3136.

HET SURVIVAL 92.24

TOTAL SURVIVAL 105.44

COMP 1 SURVIVAL 119.79

COMP 2 SURVIVAL 115.14

EXPERIMENT 73 BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2		
6 A	25.42	59.14	15.03	24.02	24.15	40.62	40.83	FLT 6000 R PACKAGE	FILTER 2
6 B	26.23	65.30	17.13	20.94	23.78	32.08	36.42	FLT 6000 R PACKAGE	FILTER 2

DOSE 2864.

HET SURVIVAL 92.03

TOTAL SURVIVAL 100.81

COMP 1 SURVIVAL 105.42

COMP 2 SURVIVAL 84.51

EXPERIMENT 73 BIOSATELLITE FLIGHT CAE+LIE+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
20	A	26.95	57.95	15.62	19.61	23.16	33.83	39.96	FLT 6000 R PACKAGE FILTER 4
20	B	25.19	56.88	14.33	21.54	26.18	37.88	46.02	FLT 6000 R PACKAGE FILTER 4

DOSE 2419.

HET SURVIVAL 86.54

TOTAL SURVIVAL 93.03

COMP 1 SURVIVAL 96.48

COMP 2 SURVIVAL 86.99

EXPERIMENT 73 BIOSATELLITE FLIGHT CAE+LIE+CONRAD DOSIMETRY DATE 06-10-68

		PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
7	A	27.36	61.83	16.92	31.16	35.17	50.39	56.89	FLT 6000 R PACKAGE FILTER 6
7	B	20.21	71.08	14.36	27.87	43.57	39.21	61.30	FLT 6000 R PACKAGE FILTER 6

DOSE 2072.

HET SURVIVAL 90.39

TOTAL SURVIVAL 107.67

COMP 1 SURVIVAL 138.39

COMP 2 SURVIVAL 138.94

EXPERIMENT 73 BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY DATE 06-10-68

	PC HET	TOT. VIA.	HET. VIA.	COMP 1	COMP 2	PC COMP 1	PC COMP 2	
8 A	19.46	62.34	12.13	26.49	33.73	42.50	54.11	FLT 6000 R PACKAGE FILTER 9
8 B	22.78	62.56	14.25	28.05	30.50	44.84	48.75	FLT 6000 R PACKAGE FILTER 9

DOSE 1679.

HET SURVIVAL 76.24

TOTAL SURVIVAL 101.19

COMP 1 SURVIVAL 127.89

COMP 2 SURVIVAL 113.26

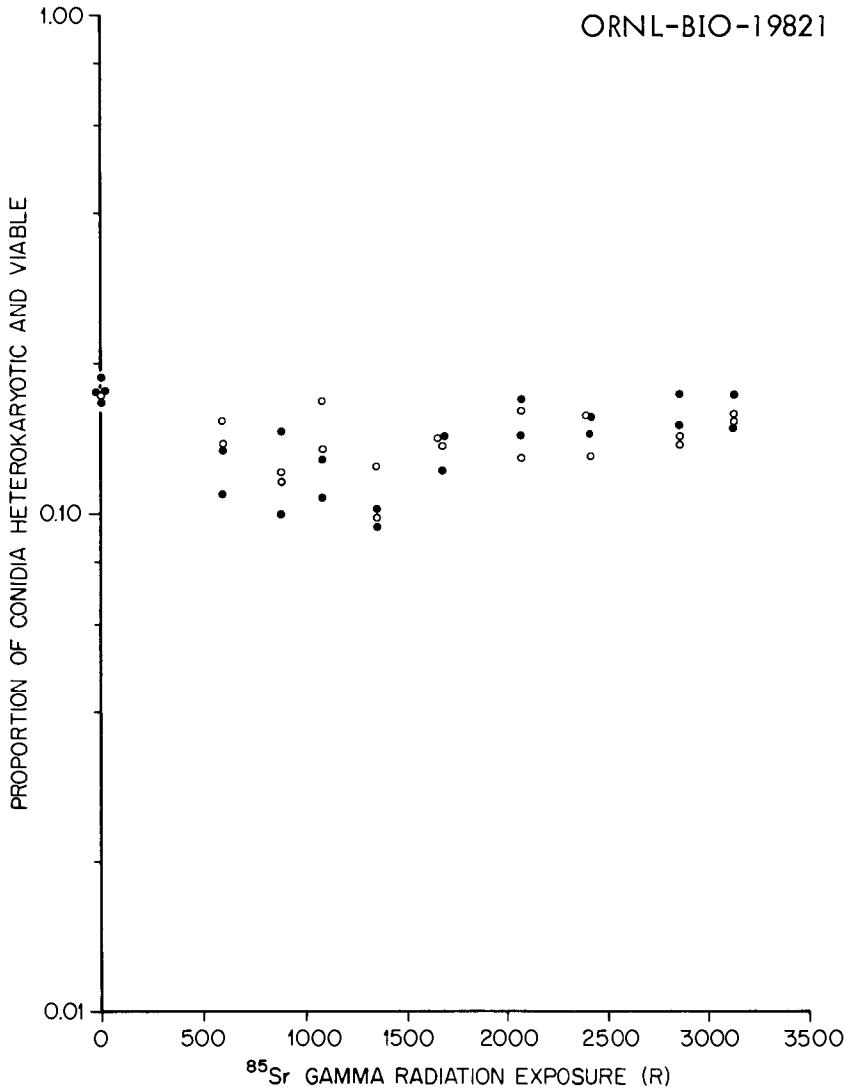

Fig. 3. Survival of Heterokaryotic Conidia

Estimates (based on plating data) of proportion of viable heterokaryotic conidia, plotted on a logarithmic scale against ^{85}Sr gamma radiation exposure on a linear scale. (● = conidia from flight vehicle; O = conidia from ground-control vehicle.)

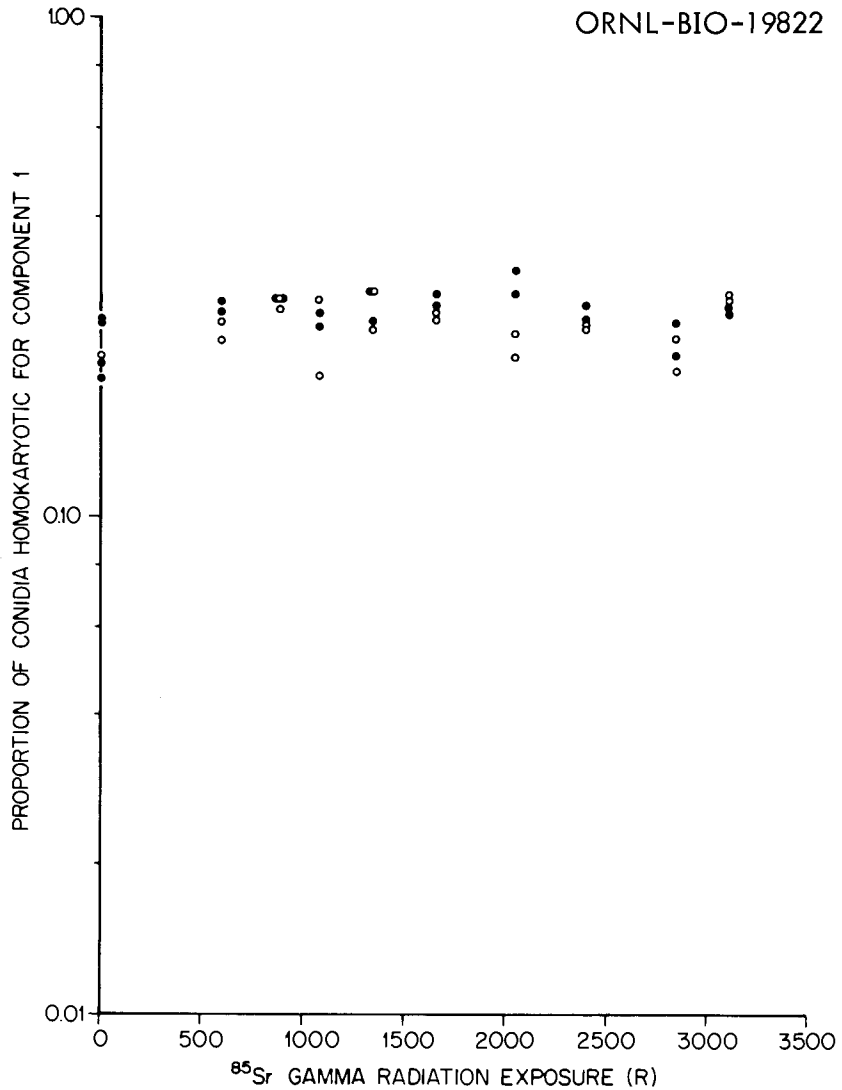

Fig. 4. Survival of Conidia Homokaryotic for Component 1

Estimates (based on plating data) of proportion of viable conidia homokaryotic for component 1, plotted on a logarithmic scale against ^{85}Sr gamma radiation exposure on a linear scale. (● = conidia from flight vehicle; O = conidia from ground-control vehicle.)

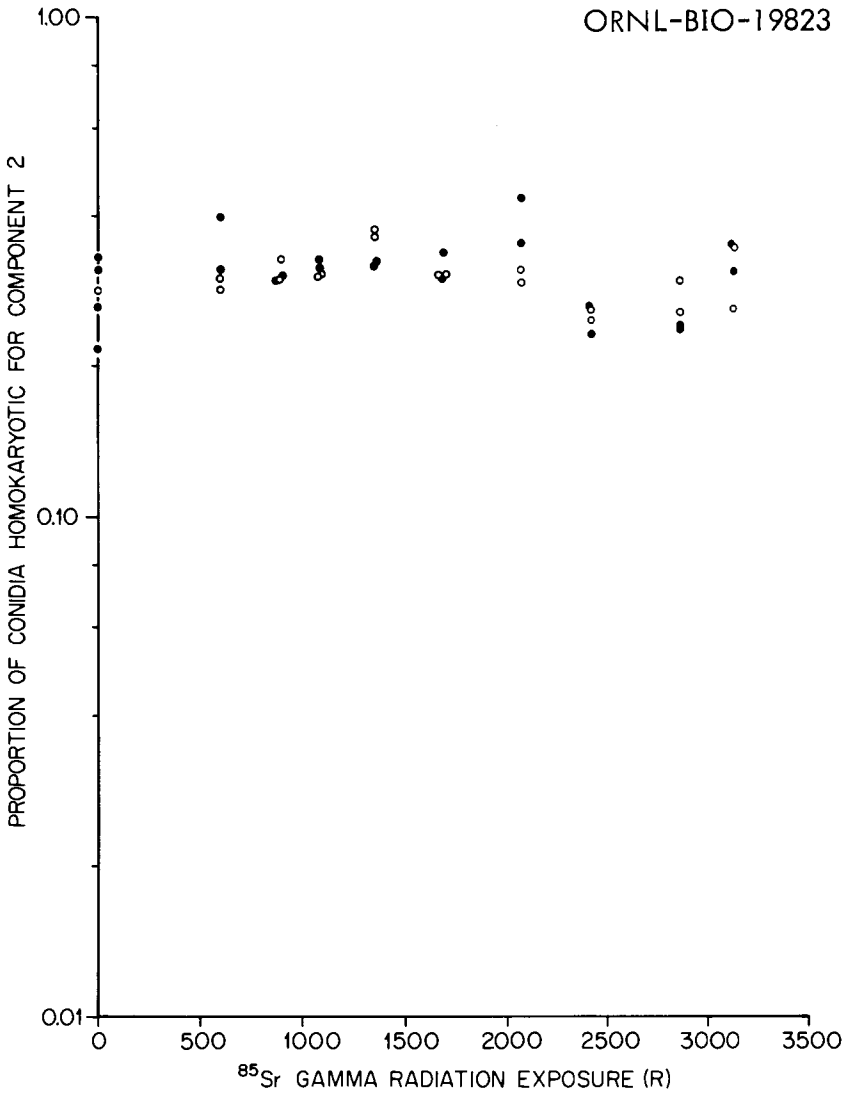

Fig. 5. Survival of Conidia Homokaryotic for Component 2

Estimates (based on plating data) of proportion of viable conidia homokaryotic for component 2, plotted on a logarithmic scale against gamma radiation exposure on a linear scale. (● = conidia from flight vehicle; O = conidia from ground-control vehicle.)

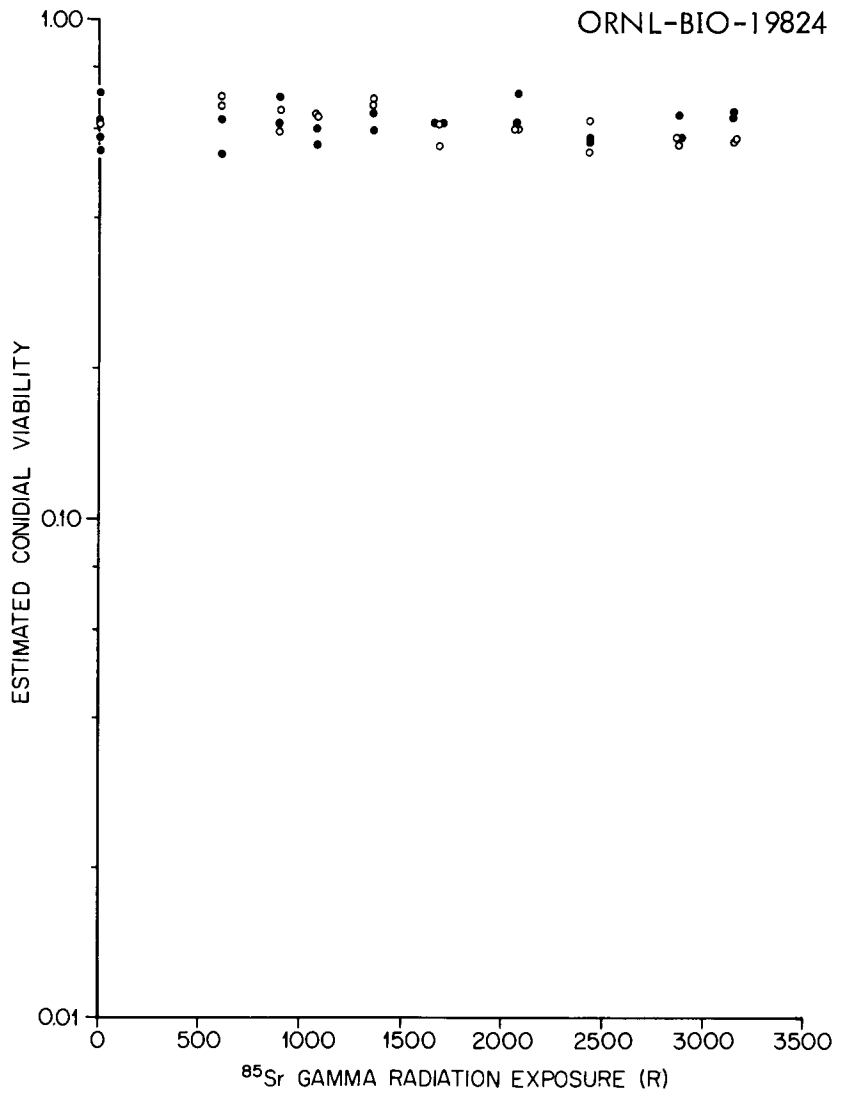

Fig. 6. General Conidia Survival

Estimates (based on plating data) of proportion of conidia which are capable of forming colonies in a completely supplemented medium, plotted on a logarithmic scale against radiation exposure on a linear scale. (● = conidia from flight vehicle; O = conidia from ground-control vehicle.)

IV. DATA FROM EXPERIMENTS WITH SAMPLES ANALYZED IN LIQUID MEDIUM

The procedures for inoculation of conidia into 12-liter flasks of liquid medium and their incubation have been described previously in ORNL-TM-1734, and the data sheet (Form No. 80213) for recording the data from liquid cultures was introduced in ORNL-TM-2189. The experimental plan (ORNL-TM-2235) called for eight flasks for each of the irradiated samples (from nine different total exposures in the flight vehicle and nine in the ground-control vehicle), six flasks for each of the two unirradiated samples from the flight vehicle and two from the ground-control vehicle, and four flasks for each of three unirradiated samples which were incubated under controlled temperature conditions on the ground during flight.

The data from liquid medium cultures are presented and analyzed in four different types of print-outs. Those appearing on pp. 30-36 include the basic data for each flask from which valid data were obtained, as well as estimates of mutation frequency for ad-3 mutants for individual flasks, and for all flasks in a given treatment combined. Those on pp. 37-42 indicate the estimated heterokaryotic surviving proportion for each flask. Those on pp. 43-52 indicate for each treatment the best estimate of survival proportion and forward-mutation frequency, obtained by combining the information from all the flasks representing that treatment. In these print-outs, the latest estimate of gamma radiation exposure is also related to the treatment number. The print-outs on pp. 53-56 indicate, for the flight and ground-control series separately, the regression analyses for logarithm of purple mutant frequency vs. logarithm of exposure, and for logarithm of heterokaryotic survival vs. exposure (linear scale). The additional discussion will be based on the data from these print-outs.

LISTING OF JUG HARVESTING DATA DATE 06-06-68

EXPERIMENT	JUG	VOL-INOC	VOL-CT	BACKGROUND	JUG-VOL	MUTANTS	TOTAL SURVIVORS	MUT.-FREQ.	ISOLATES		95 PC CONFIDENCE	
12 73 1	79	1.00	60.	5267.	9525.	0.0	836136.	0.0	0	0		
12 73 1	87	1.00	60.	3434.	9450.	0.0	540855.	0.0	0	0		
12 73 1	109	1.00	60.	3262.	9600.	1.	521920.	0.191600E-05	1	1		
12 73 1	125	1.00	60.	2855.	9750.	0.0	463937.	0.0	0	0		
12 73 1	168	1.00	60.	3154.	9850.	0.0	517782.	0.0	0	0		
						1.	2880628.	0.347147E-06			0.1770E-07	0.1848E-05
12 73 2	9	1.00	60.	4118.	9550.	0.0	655448.	0.0	0	0		
12 73 2	22	1.00	60.	3667.	9350.	0.0	571441.	0.0	0	0		
12 73 2	42	1.00	60.	4255.	9600.	0.0	680800.	0.0	0	0		
12 73 2	95	1.00	60.	3441.	9450.	0.0	541957.	0.0	0	0		
12 73 2	113	1.00	60.	3411.	9450.	1.	537232.	0.186139E-05	2	2		
12 73 2	146	1.00	60.	3832.	9400.	1.	600347.	0.166570E-05	3	3		
						2.	3587224.	0.557534E-06			0.9896E-07	0.1864E-05
12 73 3	30	1.00	60.	3507.	9650.	0.0	564042.	0.0	0	0		
12 73 3	75	1.00	60.	5385.	9500.	0.0	852625.	0.0	0	0		
12 73 3	111	1.00	60.	3391.	9500.	0.0	536908.	0.0	0	0		
12 73 3	129	1.00	60.	3407.	9800.	0.0	556476.	0.0	0	0		
12 73 3	160	1.00	60.	3705.	9650.	0.0	595887.	0.0	0	0		
12 73 3	167	1.00	60.	3405.	9800.	0.0	556150.	0.0	0	0		
						0.0	3662087.	0.0			0.0	0.8970E-06
12 73 4	3	1.00	60.	3741.	9550.	0.0	595442.	0.0	0	0		
12 73 4	46	1.00	60.	4336.	9700.	0.0	700987.	0.0	0	0		
12 73 4	64	1.00	60.	4229.	9550.	0.0	673116.	0.0	0	0		
12 73 4	91	1.00	60.	3635.	9750.	0.0	590687.	0.0	0	0		
12 73 4	132	1.00	60.	3314.	9750.	1.	538525.	0.185692E-05	4	4		
12 73 4	150	1.00	60.	3078.	9550.	1.	489915.	0.204117E-05	5	5		
						2.	3588669.	0.557310E-06			0.9892E-07	0.1863E-05
12 73 5	24	1.00	60.	2830.	9450.	31.	445725.	0.695496E-04	1000	1030		
12 73 5	51	1.00	60.	3576.	8850.	14.	527460.	0.265423E-04	1031	1044		

LISTING OF JUG HARVESTING DATA DATE 06-06-68

EXPERIMENT			JUG	VOL-INOC	VOL-CT	BACKGROUND	JUG-VOL	MUTANTS	TOTAL SURVIVORS	MUT.-FREQ.	ISOLATES		95 PC CONFIDENCE	
12	73	5	67	1.00	60.	3676.	9500.	20.	582033.	0.343623E-04	1045	1064		
12	73	5	84	1.00	60.	2516.	9450.	17.	396270.	0.429001E-04	1065	1081		
12	73	5	112	1.00	60.	3007.	9600.	17.	481120.	0.353342E-04	1082	1098		
12	73	5	135	0.55	60.	1728.	9600.	12.	276480.	0.434028E-04	1099	1110		
12	73	5	153	1.00	60.	2585.	9550.	22.	411446.	0.534700E-04	1111	1132		
12	73	5	166	1.00	60.	2680.	9750.	27.	435500.	0.619977E-04	1133	1159		
								160.	3556032.	0.449940E-04			0.3822E-04	0.5206E-04
12	73	6	2	1.00	60.	3196.	9400.	18.	500707.	0.359492E-04	1201	1218		
12	73	6	45	1.00	60.	4126.	9550.	28.	656722.	0.426360E-04	1219	1246		
12	73	6	71	1.00	60.	4175.	9600.	21.	668000.	0.314371E-04	1247	1267		
12	73	6	83	1.00	60.	2829.	9500.	13.	447925.	0.290227E-04	1268	1280		
12	73	6	105	1.00	60.	3155.	9400.	15.	494283.	0.303470E-04	1281	1295		
12	73	6	133	1.00	60.	3248.	9750.	17.	527800.	0.322092E-04	1296	1312		
12	73	6	157	1.00	60.	3291.	9550.	18.	523817.	0.343631E-04	1313	1330		
12	73	6	174	0.90	60.	2692.	9600.	8.	430720.	0.185735E-04	1331	1338		
								138.	4249972.	0.324708E-04			0.2702E-04	0.3830E-04
12	73	7	28	1.00	60.	3572.	9800.	16.	583427.	0.274242E-04	1601	1616		
12	73	7	60	1.00	60.	4387.	9150.	14.	669017.	0.209262E-04	1617	1630		
12	73	7	61	1.00	60.	3816.	9700.	21.	616920.	0.340401E-04	1631	1651		
12	73	7	88	1.00	60.	2636.	9500.	15.	417367.	0.359396E-04	1652	1666		
12	73	7	114	1.00	60.	3219.	9600.	15.	515040.	0.291239E-04	1667	1681		
12	73	7	121	1.00	60.	2968.	9650.	12.	477353.	0.251386E-04	1682	1693		
12	73	7	154	1.00	60.	2953.	9500.	6.	467558.	0.128326E-04	1694	1699		
12	73	7	162	0.41	60.	1528.	10000.	11.	254667.	0.431937E-04	1700	1710		
								110.	4001346.	0.274907E-04			0.2230E-04	0.3300E-04
12	73	8	18	1.00	60.	3463.	9400.	18.	542536.	0.331775E-04	1801	1818		
12	73	8	31	1.00	60.	4050.	9400.	16.	634500.	0.252167E-04	1819	1834		
12	73	8	44	1.00	60.	4130.	9750.	11.	671125.	0.163904E-04	1835	1845		
12	73	8	78	1.00	60.	4835.	9650.	11.	777629.	0.141456E-04	1846	1856		

LISTING OF JUG HARVESTING DATA DATE 06-06-68

EXPERIMENT			JUG	VOL-INOC	VOL-CT	BACKGROUND	JUG-VOL	MUTANTS	TOTAL SURVIVORS	MUT.-FREQ.	ISOLATES	95 PC CONFIDENCE	
12	73	8	82	1.00	60.	2565.	9800.	14.	418950.	0.334169E-04	1857 1870		
12	73	8	142	1.00	60.	3095.	9600.	9.	495200.	0.181745E-04	1871 1879		
12	73	8	170	0.70	60.	1715.	9850.	6.	281546.	0.213109E-04	1880 1885		
								85.	3821483.	0.222427E-04		0.1747E-04	0.2732E-04
12	73	9	16	1.00	60.	2397.	9600.	11.	383520.	0.286817E-04	3000 3010		
12	73	9	34	1.00	60.	3456.	9550.	24.	549762.	0.436553E-04	3011 3034		
12	73	9	52	1.00	60.	4072.	9000.	23.	610950.	0.376463E-04	3035 3057		
12	73	9	70	1.00	60.	3494.	9500.	15.	553216.	0.271141E-04	3058 3072		
12	73	9	108	1.00	60.	2616.	9600.	30.	418560.	0.716743E-04	3073 3102		
12	73	9	140	0.78	60.	2476.	9550.	28.	394096.	0.710486E-04	3103 3130		
12	73	9	151	1.00	60.	2845.	9650.	15.	457571.	0.327818E-04	3131 3145		
								146.	3367673.	0.433534E-04		0.3634E-04	0.5042E-04
12	73	10	4	1.00	60.	2869.	9450.	27.	451867.	0.597520E-04	3201 3227		
12	73	10	37	1.00	60.	3583.	9650.	31.	576266.	0.537946E-04	3228 3258		
12	73	10	55	1.00	60.	3853.	9150.	22.	587582.	0.374416E-04	3259 3280		
12	73	10	68	1.00	60.	4028.	9650.	37.	647836.	0.571132E-04	3281 3317		
12	73	10	86	1.00	60.	2583.	9450.	23.	406822.	0.565357E-04	3318 3340		
12	73	10	124	1.00	60.	2705.	9750.	19.	439562.	0.432248E-04	3341 3359		
12	73	10	158	1.00	60.	2959.	9600.	20.	473440.	0.422440E-04	3360 3379		
12	73	10	172	0.90	60.	2081.	9600.	10.	332960.	0.300336E-04	3380 3389		
								189.	3916335.	0.482594E-04		0.4157E-04	0.5536E-04
12	73	11	13	1.00	60.	3605.	9400.	20.	564783.	0.354118E-04	3601 3620		
12	73	11	25	1.00	60.	3692.	9600.	15.	590720.	0.253927E-04	3621 3635		
12	73	11	53	1.00	60.	3899.	9500.	22.	617342.	0.356367E-04	3636 3657		
12	73	11	72	1.00	60.	4272.	9650.	21.	687080.	0.305641E-04	3658 3678		
12	73	11	96	1.00	60.	3422.	9450.	8.	538965.	0.148433E-04	3679 3686		
12	73	11	107	1.00	60.	2922.	9700.	9.	472390.	0.190521E-04	3687 3695		
12	73	11	145	1.00	60.	3243.	9850.	19.	532392.	0.356880E-04	3696 3714		
12	73	11	179	1.00	60.	2448.	9850.	16.	401880.	0.398129E-04	3715 3730		
								130.	4405549.	0.295082E-04		0.2477E-04	0.3472E-04

LISTING OF JUG HARVESTING DATA DATE 06-06-68

EXPERIMENT			JUG	VOL-INOC	VOL-CT	BACKGROUND	JUG-VOL	MUTANTS	TOTAL SURVIVORS	MUT.-FREQ.	ISOLATES		95 PC CONFIDENCE	
12	73	12	15	1.00	60.	4037.	9350.	11.	629099.	0.174853E-04	3801	3811		
12	73	12	29	1.00	60.	4350.	9500.	7.	688750.	0.101633E-04	3812	3818		
12	73	12	41	1.00	60.	3750.	9650.	12.	603125.	0.198964E-04	3819	3830		
12	73	12	74	1.00	60.	5076.	9600.	14.	812160.	0.172380E-04	3831	3844		
12	73	12	94	1.00	60.	2989.	9150.	9.	455822.	0.197445E-04	3845	3853		
12	73	12	117	1.00	60.	3106.	9550.	6.	494371.	0.121366E-04	3854	3859		
12	73	12	128	1.00	60.	3303.	9450.	11.	520222.	0.211448E-04	3860	3870		
12	73	12	161	0.44	60.	1476.	9800.	4.	241080.	0.165920E-04	3871	3874		
								74.	4444627.	0.166493E-04			0.1321E-04	0.2065E-04
12	73	13	8	1.00	60.	4285.	9400.	0.0	671316.	0.0	0	0		
12	73	13	62	1.00	60.	5042.	9550.	1.	802518.	0.124608E-05	6	6		
12	73	13	90	1.00	60.	3622.	9500.	0.0	573483.	0.0	0	0		
12	73	13	149	1.00	60.	3555.	9600.	0.0	568800.	0.0	0	0		
								1.	2616117.	0.382246E-06			0.1949E-07	0.2035E-05
12	73	14	12	1.00	60.	4670.	9500.	0.0	739416.	0.0	0	0		
12	73	14	23	1.00	60.	4541.	9650.	1.	730344.	0.136922E-05	7	7		
12	73	14	106	1.00	60.	3867.	9550.	1.	615497.	0.162470E-05	8	8		
12	73	14	165	1.00	60.	3642.	9900.	0.0	600930.	0.0	0	0		
								2.	2686186.	0.744550E-06			0.1322E-06	0.2489E-05
12	73	15	11	1.00	60.	4081.	9450.	1.	642757.	0.155580E-05	9	9		
12	73	15	33	1.00	60.	5119.	9550.	0.0	814774.	0.0	0	0		
12	73	15	104	1.00	60.	3396.	9550.	1.	540530.	0.185004E-05	10	10		
12	73	15	127	1.00	60.	3251.	9700.	0.0	525578.	0.0	0	0		
								2.	2523638.	0.792507E-06			0.1407E-06	0.2649E-05
12	73	16	32	1.00	60.	4249.	9450.	13.	669217.	0.194257E-04	2001	2013		
12	73	16	50	1.00	60.	3891.	9600.	9.	622560.	0.144564E-04	2014	2022		
12	73	16	65	1.00	60.	3900.	9500.	4.	617500.	0.647773E-05	2023	2026		
12	73	16	115	1.00	60.	2765.	9650.	10.	444704.	0.224869E-04	2027	2036		
12	73	16	131	1.00	60.	3035.	9700.	14.	490658.	0.285331E-04	2037	2050		

EXPERIMENT	JUG	VOL-INOC	VOL-CT	BACKGROUND	JUG-VOL	MUTANTS	TOTAL SURVIVORS	MUT.-FREQ.	ISOLATES	95 PC CONFIDENCE	
12 73 16	148	1.00	60.	2746.	9550.	9.	437071.	0.205916E-04	2051 2059		
12 73 16	173	1.00	60.	3061.	9750.	7.	497412.	0.140728E-04	2060 2066		
						66.	3779122.	0.174644E-04		0.1357E-04	0.2200E-04
12 73 17	14	1.00	60.	3743.	9550.	4.	595761.	0.671410E-05	2201 2204		
12 73 17	35	1.00	60.	3748.	9750.	7.	609050.	0.114933E-04	2205 2211		
12 73 17	48	1.00	60.	3735.	9850.	6.	613162.	0.978534E-05	2212 2217		
12 73 17	66	1.00	60.	3740.	9675.	2.	603075.	0.331634E-05	2218 2219		
12 73 17	81	1.00	60.	2867.	9400.	6.	449163.	0.133582E-04	2220 2225		
12 73 17	103	1.00	60.	2584.	9600.	3.	413440.	0.725619E-05	2026 2028		
12 73 17	141	1.00	60.	2802.	9750.	13.	455325.	0.285510E-04	2229 2241		
12 73 17	169	0.79	60.	2952.	9750.	5.	479700.	0.104232E-04	2242 2246		
						46.	4218673.	0.109039E-04		0.8071E-05	0.1428E-04
12 73 18	10	1.00	60.	4084.	9450.	2.	643230.	0.310931E-05	2401 2402		
12 73 18	49	1.00	60.	3819.	9600.	10.	611040.	0.163655E-04	2403 2412		
12 73 18	69	1.00	60.	4227.	9650.	4.	679842.	0.588372E-05	2413 2416		
12 73 18	92	1.00	60.	3135.	9325.	3.	487231.	0.615724E-05	2417 2419		
12 73 18	102	1.00	60.	2834.	9500.	5.	448716.	0.111429E-04	2420 2424		
12 73 18	138	1.00	60.	3731.	9700.	3.	603178.	0.497365E-05	2425 2427		
12 73 18	156	1.00	60.	3391.	9600.	3.	542560.	0.552934E-05	2428 2430		
						30.	4015796.	0.747050E-05		0.5063E-05	0.1040E-04
12 73 19	17	1.00	60.	3184.	9450.	3.	501480.	0.598229E-05	2601 2603		
12 73 19	26	1.00	60.	3663.	9550.	7.	583027.	0.120063E-04	2604 2610		
12 73 19	59	1.00	60.	4062.	9600.	4.	649920.	0.615460E-05	2611 2614		
12 73 19	85	1.00	60.	2361.	9400.	2.	369890.	0.540702E-05	2615 2616		
12 73 19	118	1.00	60.	3614.	9550.	3.	575228.	0.521532E-05	2617 2619		
12 73 19	123	1.00	60.	4435.	9575.	4.	707752.	0.565170E-05	2620 2623		
12 73 19	159	1.00	60.	3010.	9525.	1.	477837.	0.209276E-05	2624 2624		
12 73 19	177	0.56	60.	2563.	9650.	2.	412216.	0.485183E-05	2625 2626		
						26.	4277348.	0.607853E-05		0.3921E-05	0.8807E-05

LISTING OF JUG HARVESTING DATA DATE 06-06-68

EXPERIMENT	JUG	VOL-INOC	VOL-CT	BACKGROUND	JUG-VOL	MUTANTS	TOTAL SURVIVORS	MUT.-FREQ.	ISOLATES	95 PC CONFIDENCE	
12 73 20	20	1.00	60.	3885.	9450.	17.	611887.	0.277829E-04	1401 1417		
12 73 20	36	1.00	60.	3910.	9550.	18.	622342.	0.289230E-04	1418 1435		
12 73 20	47	1.00	60.	4013.	10100.	15.	675522.	0.222051E-04	1436 1450		
12 73 20	97	1.00	60.	3276.	9550.	10.	521430.	0.191780E-04	1451 1460		
12 73 20	101	1.00	60.	3445.	9350.	20.	536846.	0.372546E-04	1461 1480		
12 73 20	134	1.00	60.	3902.	9600.	17.	624320.	0.272296E-04	1481 1497		
12 73 20	178	0.81	60.	2913.	9650.	10.	468507.	0.213444E-04	1498 1507		
						107.	4060851.	0.263492E-04		0.2154E-04	0.3147E-04
12 73 21	19	1.00	60.	3483.	9575.	4.	555828.	0.719646E-05	4001 4004		
12 73 21	39	1.00	60.	3421.	9600.	5.	547360.	0.913476E-05	4005 4009		
12 73 21	58	1.00	60.	4102.	9500.	8.	649483.	0.123175E-04	4010 4017		
12 73 21	63	1.00	60.	3354.	9475.	14.	529652.	0.264324E-04	4018 4031		
12 73 21	116	1.00	60.	2454.	9450.	6.	386505.	0.155237E-04	4032 4037		
12 73 21	122	1.00	60.	2983.	9650.	6.	479766.	0.125061E-04	4038 4043		
12 73 21	155	1.00	60.	3009.	9400.	13.	471410.	0.275769E-04	4044 4056		
12 73 21	176	0.47	60.	1353.	9550.	6.	215352.	0.278613E-04	4029 4062		
						62.	3835353.	0.161654E-04		0.1243E-04	0.2053E-04
12 73 22	6	1.00	60.	3634.	9425.	5.	570841.	0.875901E-05	4201 4205		
12 73 22	40	1.00	60.	3539.	9400.	9.	554443.	0.162325E-04	4206 4214		
12 73 22	57	1.00	60.	4235.	9650.	8.	681129.	0.117452E-04	4215 4222		
12 73 22	73	1.00	60.	3890.	9725.	6.	630504.	0.951620E-05	4223 4228		
12 73 22	89	1.00	60.	3063.	9550.	8.	487527.	0.164093E-04	4229 4236		
12 73 22	137	1.00	60.	3052.	9700.	6.	493407.	0.121604E-04	4237 4242		
12 73 22	143	1.00	60.	2808.	9725.	9.	455130.	0.197746E-04	4243 4251		
12 73 22	171	0.66	60.	1992.	9650.	9.	320380.	0.280916E-04	4252 4260		
						60.	4193358.	0.143083E-04		0.1080E-04	0.1807E-04
12 73 23	7	1.00	60.	3208.	9450.	4.	505260.	0.791672E-05	4401 4404		
12 73 23	27	1.00	60.	3831.	9600.	7.	612960.	0.114200E-04	4405 4411		
12 73 23	56	1.00	60.	4323.	9400.	5.	677270.	0.738258E-05	4412 4416		

LISTING OF JUG HARVESTING DATA DATE 06-06-68

EXPERIMENT	JUG	VOL-INOC	VOL-CT	BACKGROUND	JUG-VOL	MUTANTS	TOTAL SURVIVORS	MUT.-FREQ.	ISOLATES	95 PC CONFIDENCE	
12 73 23	76	1.00	60.	4370.	9550.	6.	695558.	0.862617E-05	4417 4422		
12 73 23	100	1.00	60.	3286.	9450.	6.	517545.	0.115932E-04	4423 4428		
12 73 23	110	1.00	60.	2921.	9650.	4.	469794.	0.851437E-05	4429 4432		
12 73 23	139	1.00	60.	3096.	9650.	5.	497940.	0.100414E-04	4433 4437		
12 73 23	164	0.40	60.	1383.	9750.	7.	224737.	0.311474E-04	4438 4444		
						44.	4201062.	0.104735E-04		0.7539E-05	0.1398E-04
12 73 24	5	2.00	60.	3616.	9250.	1.	557467.	0.179383E-05	4601 4601		
12 73 24	38	2.00	60.	4072.	9350.	6.	634553.	0.945547E-05	4602 4607		
12 73 24	43	2.00	60.	3952.	9625.	2.	633967.	0.315474E-05	4608 4609		
12 73 24	99	2.00	60.	3825.	9600.	5.	612000.	0.816993E-05	4610 4614		
12 73 24	119	2.00	60.	3193.	9300.	2.	494915.	0.404110E-05	4615 4616		
12 73 24	126	2.00	60.	3447.	9300.	5.	534285.	0.935830E-05	4617 4621		
12 73 24	152	1.10	60.	2026.	9600.	1.	324160.	0.308490E-05	4622 4622		
						22.	3791343.	0.580269E-05		0.3631E-05	0.8513E-05
12 73 25	21	1.00	60.	3496.	9550.	22.	556447.	0.395366E-04	3401 3422		
12 73 25	54	1.00	60.	3965.	9350.	23.	617879.	0.372241E-04	3423 3445		
12 73 25	80	1.00	60.	4265.	9700.	17.	689508.	0.246553E-04	3446 3462		
12 73 25	98	1.00	60.	3336.	9450.	14.	525420.	0.266453E-04	3463 3476		
12 73 25	120	1.00	60.	3366.	9500.	22.	532950.	0.412797E-04	3477 3498		
12 73 25	136	1.00	60.	3425.	9550.	22.	545146.	0.403562E-04	3499 3520		
12 73 25	147	1.00	60.	3249.	9450.	17.	511717.	0.332215E-04	3521 3537		
12 73 25	180	0.26	60.	1087.	9750.	7.	176637.	0.396292E-04	3538 3544		
						144.	4155701.	0.346512E-04		0.2896E-04	0.4075E-04

BIOSATELLITE GROUND CONTROL CAF+LIE+CONRAD DOSIMETRY

EXP.	TR.	DOSE	JUG	ISOLATES	PURPLES		FORWARD MUTATION FREQUENCY	PROPORTION HETEROKARYOTIC SURVIVORS	CONIDIA PER ML	VOLUME (ML) ADDED	CONIDIA IN FLASK
73	3	0.0	30	0	0	0.0	0.0	0.1169	4825000.	1.00	4825000.
73	3	0.0	75	0	0	0.0	0.0	0.1767	4825000.	1.00	4825000.
73	3	0.0	111	0	0	0.0	0.0	0.1113	4825000.	1.00	4825000.
73	3	0.0	129	0	0	0.0	0.0	0.1153	4825000.	1.00	4825000.
73	3	0.0	160	0	0	0.0	0.0	0.1235	4825000.	1.00	4825000.
73	3	0.0	167	0	0	0.0	0.0	0.1153	4825000.	1.00	4825000.
73	15	0.0	11	9	9	1.	0.1555797D-05	0.1624	3958333.	1.00	3958333.
73	15	0.0	33	0	0	0.0	0.0	0.2058	3958333.	1.00	3958333.
73	15	0.0	104	10	10	1.	0.1850036D-05	0.1366	3958333.	1.00	3958333.
73	15	0.0	127	0	0	0.0	0.0	0.1328	3958333.	1.00	3958333.
73	14	0.0	12	0	0	0.0	0.0	0.1621	4562500.	1.00	4562500.
73	14	0.0	23	7	7	1.	0.1369217D-05	0.1601	4562500.	1.00	4562500.
73	14	0.0	106	8	8	1.	0.1624702D-05	0.1349	4562500.	1.00	4562500.
73	14	0.0	165	0	0	0.0	0.0	0.1317	4562500.	1.00	4562500.
73	13	0.0	8	0	0	0.0	0.0	0.1618	4150000.	1.00	4150000.
73	13	0.0	62	6	6	1.	0.1246077D-05	0.1934	4150000.	1.00	4150000.
73	13	0.0	90	0	0	0.0	0.0	0.1382	4150000.	1.00	4150000.
73	13	0.0	149	0	0	0.0	0.0	0.1371	4150000.	1.00	4150000.
73	4	0.0	3	0	0	0.0	0.0	0.1393	4275000.	1.00	4275000.
73	4	0.0	46	0	0	0.0	0.0	0.1640	4275000.	1.00	4275000.
73	4	0.0	64	0	0	0.0	0.0	0.1575	4275000.	1.00	4275000.
73	4	0.0	91	0	0	0.0	0.0	0.1382	4275000.	1.00	4275000.
73	4	0.0	132	4	4	1.	0.1856924D-05	0.1260	4275000.	1.00	4275000.
73	4	0.0	150	5	5	1.	0.2041170D-05	0.1146	4275000.	1.00	4275000.
73	24	597.	5	4601	4601	1.	0.1793829D-05	0.1417	1966667.	2.00	3933333.
73	24	597.	38	4602	4607	6.	0.9455470D-05	0.1613	1966667.	2.00	3933333.
73	24	597.	43	4608	4609	2.	0.3154740D-05	0.1612	1966667.	2.00	3933333.
73	24	597.	99	4610	4614	5.	0.8169935D-05	0.1556	1966667.	2.00	3933333.
73	24	597.	119	4615	4616	2.	0.4041098D-05	0.1258	1966667.	2.00	3933333.

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

Exp.	Tr.	Dose	Jug	Isolates		Purples	Forward Mutation Frequency	Proportion Heterokaryotic Survivors	Conidia per ml	Volume (ml) Added	Conidia in Flask
73	24	597.	126	4617	4621	5.	0.9358301D-05	0.1358	1966667.	2.00	3933333.
73	24	597.	152	4622	4622	1.	0.3084896D-05	0.1498	1966667.	1.10	2163333.
73	21	1353.	19	4001	4004	4.	0.7196461D-05	0.1395	3983333.	1.00	3983333.
73	21	1353.	39	4005	4009	5.	0.9134756D-05	0.1374	3983333.	1.00	3983333.
73	21	1353.	58	4010	4017	8.	0.1231748D-04	0.1631	3983333.	1.00	3983333.
73	21	1353.	63	4018	4031	14.	0.2643243D-04	0.1330	3983333.	1.00	3983333.
73	21	1353.	116	4032	4037	6.	0.1552373D-04	0.0970	3983333.	1.00	3983333.
73	21	1353.	122	4038	4043	6.	0.1250610D-04	0.1204	3983333.	1.00	3983333.
73	21	1353.	155	4044	4056	13.	0.2757684D-04	0.1183	3983333.	1.00	3983333.
73	21	1353.	176	4057	4062	6.	0.2786130D-04	0.1150	3983333.	0.47	1872167.
73	22	1084.	6	4201	4205	5.	0.8759009D-05	0.1480	3858333.	1.00	3858333.
73	22	1084.	40	4206	4214	9.	0.1623250D-04	0.1437	3858333.	1.00	3858333.
73	22	1084.	57	4215	4222	8.	0.1174520D-04	0.1765	3858333.	1.00	3858333.
73	22	1084.	73	4223	4228	6.	0.9516194D-05	0.1634	3858333.	1.00	3858333.
73	22	1084.	89	4229	4236	8.	0.1640933D-04	0.1264	3858333.	1.00	3858333.
73	22	1084.	137	4237	4242	6.	0.1216035D-04	0.1279	3858333.	1.00	3858333.
73	22	1084.	143	4243	4251	9.	0.1977457D-04	0.1180	3858333.	1.00	3858333.
73	22	1084.	171	4252	4260	9.	0.2309164D-04	0.1258	3858333.	0.66	2546500.
73	23	890.	7	4401	4404	4.	0.7916716D-05	0.1253	4033333.	1.00	4033333.
73	23	890.	27	4405	4411	7.	0.1141999D-04	0.1520	4033333.	1.00	4033333.
73	23	890.	56	4412	4416	5.	0.7382580D-05	0.1679	4033333.	1.00	4033333.
73	23	890.	76	4417	4422	6.	0.8626164D-05	0.1725	4033333.	1.00	4033333.
73	23	890.	100	4423	4428	6.	0.1159319D-04	0.1283	4033333.	1.00	4033333.
73	23	890.	110	4429	4432	4.	0.8514367D-05	0.1165	4033333.	1.00	4033333.
73	23	890.	139	4433	4437	5.	0.1004137D-04	0.1235	4033333.	1.00	4033333.
73	23	890.	164	4438	4444	7.	0.3114745D-04	0.1393	4033333.	0.40	1613333.
73	9	3136.	16	3000	3010	11.	0.2868169D-04	0.0937	4091667.	1.00	4091667.
73	9	3136.	34	3011	3034	24.	0.4365528D-04	0.1344	4091667.	1.00	4091667.
73	9	3136.	52	3035	3057	23.	0.3764629D-04	0.1493	4091667.	1.00	4091667.
73	9	3136.	70	3058	3072	15.	0.2711415D-04	0.1352	4091667.	1.00	4091667.
73	9	3136.	108	3073	3102	30.	0.7167431D-04	0.1023	4091667.	1.00	4091667.

73	9	3136.	140	3103	3130	28.	0.7104856D-04	0.1235	4091667.	0.78	3191500.
73	9	3136.	151	3131	3145	15.	0.3278181D-04	0.1118	4091667.	1.00	4091667.
73	10	2864.	4	3201	3227	27.	0.5975203D-04	0.1082	4175000.	1.00	4175000.
73	10	2864.	37	3228	3258	31.	0.5379462D-04	0.1380	4175000.	1.00	4175000.
73	10	2864.	55	3259	3280	22.	0.3744155D-04	0.1407	4175000.	1.00	4175000.
73	10	2864.	68	3281	3317	37.	0.5711316D-04	0.1552	4175000.	1.00	4175000.
73	10	2864.	86	3318	3340	23.	0.5653571D-04	0.0974	4175000.	1.00	4175000.
73	10	2864.	124	3341	3359	19.	0.4322480D-04	0.1053	4175000.	1.00	4175000.
73	10	2864.	158	3360	3379	20.	0.4224400D-04	0.1134	4175000.	1.00	4175000.
73	10	2864.	172	3380	3389	10.	0.3003364D-04	0.0886	4175000.	0.90	3757500.
73	25	2419.	21	3401	3422	22.	0.3953658D-04	0.1294	4300000.	1.00	4300000.
73	25	2419.	54	3423	3445	23.	0.3722411D-04	0.1437	4300000.	1.00	4300000.
73	25	2419.	80	3446	3462	17.	0.2465525D-04	0.1604	4300000.	1.00	4300000.
73	25	2419.	98	3463	3476	14.	0.2664535D-04	0.1222	4300000.	1.00	4300000.
73	25	2419.	120	3477	3498	22.	0.4127967D-04	0.1239	4300000.	1.00	4300000.
73	25	2419.	136	3499	3520	22.	0.4035617D-04	0.1268	4300000.	1.00	4300000.
73	25	2419.	147	3521	3537	17.	0.3322146D-04	0.1190	4300000.	1.00	4300000.
73	25	2419.	180	3538	3544	7.	0.3962918D-04	0.1580	4300000.	0.26	1118000.
73	11	2072.	13	3601	3620	20.	0.3541181D-04	0.1339	4216667.	1.00	4216667.
73	11	2072.	25	3621	3635	15.	0.2539274D-04	0.1401	4216667.	1.00	4216667.
73	11	2072.	53	3636	3657	22.	0.3563667D-04	0.1464	4216667.	1.00	4216667.
73	11	2072.	72	3658	3678	21.	0.3056413D-04	0.1629	4216667.	1.00	4216667.
73	11	2072.	96	3679	3686	8.	0.1484326D-04	0.1278	4216667.	1.00	4216667.
73	11	2072.	107	3687	3695	9.	0.1905205D-04	0.1120	4216667.	1.00	4216667.
73	11	2072.	145	3696	3714	19.	0.3568796D-04	0.1263	4216667.	1.00	4216667.
73	11	2072.	179	3715	3730	16.	0.3981288D-04	0.0953	4216667.	1.00	4216667.
73	12	1679.	15	3801	3811	11.	0.1748532D-04	0.1455	4325000.	1.00	4325000.
73	12	1679.	29	3812	3818	7.	0.1016334D-04	0.1592	4325000.	1.00	4325000.
73	12	1679.	41	3819	3830	12.	0.1989637D-04	0.1395	4325000.	1.00	4325000.
73	12	1679.	74	3831	3844	14.	0.1723798D-04	0.1878	4325000.	1.00	4325000.
73	12	1679.	94	3845	3853	9.	0.1974453D-04	0.1054	4325000.	1.00	4325000.
73	12	1679.	117	3854	3859	6.	0.1213662D-04	0.1143	4325000.	1.00	4325000.
73	12	1679.	128	3860	3870	11.	0.2114480D-04	0.1203	4325000.	1.00	4325000.
73	12	1679.	161	3871	3874	4.	0.1659200D-04	0.1267	4325000.	0.44	1903000.

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXP.	TR.	DOSE	JUG	ISOLATES	PURPLES						
73	1	0.0	79	0	0	0.0	0.0	0.2035	4108333.	1.00	4108333.
73	1	0.0	87	0	0	0.0	0.0	0.1316	4108333.	1.00	4108333.
73	1	0.0	109	1	1	1.	0.1916002D-05	0.1270	4108333.	1.00	4108333.
73	1	0.0	125	0	0	0.0	0.0	0.1129	4108333.	1.00	4108333.
73	1	0.0	168	0	0	0.0	0.0	0.1260	4108333.	1.00	4108333.
73	2	0.0	9	0	0	0.0	0.0	0.1515	4325000.	1.00	4325000.
73	2	0.0	22	0	0	0.0	0.0	0.1321	4325000.	1.00	4325000.
73	2	0.0	42	0	0	0.0	0.0	0.1574	4325000.	1.00	4325000.
73	2	0.0	95	0	0	0.0	0.0	0.1253	4325000.	1.00	4325000.
73	2	0.0	113	2	2	1.	0.1861391D-05	0.1242	4325000.	1.00	4325000.
73	2	0.0	146	3	3	1.	0.1665704D-05	0.1388	4325000.	1.00	4325000.
73	19	597.	17	2601	2603	3.	0.5982292D-05	0.1248	4016667.	1.00	4016667.
73	19	597.	26	2604	2610	7.	0.1200629D-04	0.1452	4016667.	1.00	4016667.
73	19	597.	59	2611	2614	4.	0.6154604D-05	0.1618	4016667.	1.00	4016667.
73	19	597.	85	2615	2616	2.	0.5407013D-05	0.0921	4016667.	1.00	4016667.
73	19	597.	118	2617	2619	3.	0.5215320D-05	0.1432	4016667.	1.00	4016667.
73	19	597.	123	2620	2623	4.	0.5651697D-05	0.1762	4016667.	1.00	4016667.
73	19	597.	159	2624	2624	1.	0.2092762D-05	0.1190	4016667.	1.00	4016667.
73	19	597.	177	2625	2626	2.	0.4851827D-05	0.1833	4016667.	0.56	2249333.
73	16	1353.	32	2001	2013	13.	0.1942567D-04	0.1474	4541667.	1.00	4541667.
73	16	1353.	50	2014	2022	9.	0.1445644D-04	0.1371	4541667.	1.00	4541667.
73	16	1353.	65	2023	2026	4.	0.6477733D-05	0.1360	4541667.	1.00	4541667.
73	16	1353.	115	2027	2036	10.	0.2248686D-04	0.0979	4541667.	1.00	4541667.
73	16	1353.	131	2037	2050	14.	0.2853309D-04	0.1080	4541667.	1.00	4541667.
73	16	1353.	148	2051	2059	9.	0.2059159D-04	0.0962	4541667.	1.00	4541667.
73	16	1353.	173	2060	2066	7.	0.1407283D-04	0.1095	4541667.	1.00	4541667.
73	17	1084.	14	2201	2204	4.	0.6714104D-05	0.1349	4416667.	1.00	4416667.
73	17	1084.	35	2205	2211	7.	0.1149331D-04	0.1379	4416667.	1.00	4416667.
73	17	1084.	48	2212	2217	6.	0.9785334D-05	0.1388	4416667.	1.00	4416667.

73	17	1084.	66	2218	2219	2.	0.3316337D-05	0.1365	4416667.	1.00	4416667.
73	17	1084.	81	2220	2225	6.	0.1335817D-04	0.1017	4416667.	1.00	4416667.
73	17	1084.	103	2026	2028	3.	0.7256192D-05	0.0936	4416667.	1.00	4416667.
73	17	1084.	141	2229	2241	13.	0.2855103D-04	0.1031	4416667.	1.00	4416667.
73	17	1084.	169	2242	2246	5.	0.1042318D-04	0.1375	4416667.	0.79	3489167.
73	18	890.	10	2401	2402	2.	0.3109308D-05	0.1484	4333333.	1.00	4333333.
73	18	890.	49	2403	2412	10.	0.1636554D-04	0.1410	4333333.	1.00	4333333.
73	18	890.	69	2413	2416	4.	0.5883716D-05	0.1569	4333333.	1.00	4333333.
73	18	890.	92	2417	2419	3.	0.6157241D-05	0.1124	4333333.	1.00	4333333.
73	18	890.	102	2420	2424	5.	0.1114289D-04	0.1035	4333333.	1.00	4333333.
73	18	890.	138	2425	2427	3.	0.4973653D-05	0.1392	4333333.	1.00	4333333.
73	18	890.	156	2428	2430	3.	0.5529342D-05	0.1252	4333333.	1.00	4333333.
73	5	3136.	24	1000	1030	31.	0.6954961D-04	0.1005	4433333.	1.00	4433333.
73	5	3136.	51	1031	1044	14.	0.2654230D-04	0.1190	4433333.	1.00	4433333.
73	5	3136.	67	1045	1064	20.	0.3436229D-04	0.1313	4433333.	1.00	4433333.
73	5	3136.	84	1065	1081	17.	0.4290004D-04	0.0894	4433333.	1.00	4433333.
73	5	3136.	112	1082	1098	17.	0.3533422D-04	0.1085	4433333.	1.00	4433333.
73	5	3136.	135	1099	1110	12.	0.4340278D-04	0.1134	4433333.	0.55	2438333.
73	5	3136.	153	1111	1132	22.	0.5346998D-04	0.0928	4433333.	1.00	4433333.
73	5	3136.	166	1133	1159	27.	0.6199770D-04	0.0982	4433333.	1.00	4433333.
73	6	2864.	2	1201	1218	18.	0.3594919D-04	0.1234	4058333.	1.00	4058333.
73	6	2864.	45	1219	1246	28.	0.4263602D-04	0.1618	4058333.	1.00	4058333.
73	6	2864.	71	1247	1267	21.	0.3143713D-04	0.1646	4058333.	1.00	4058333.
73	6	2864.	83	1268	1280	13.	0.2902272D-04	0.1104	4058333.	1.00	4058333.
73	6	2864.	105	1281	1295	15.	0.3034697D-04	0.1218	4058333.	1.00	4058333.
73	6	2864.	133	1296	1312	17.	0.3220917D-04	0.1301	4058333.	1.00	4058333.
73	6	2864.	157	1313	1330	18.	0.3436311D-04	0.1291	4058333.	1.00	4058333.
73	6	2864.	174	1331	1338	8.	0.1857355D-04	0.1179	4058333.	0.90	3652500.
73	20	2419.	20	1401	1417	17.	0.2778288D-04	0.1318	4641667.	1.00	4641667.
73	20	2419.	36	1418	1435	18.	0.2892302D-04	0.1341	4641667.	1.00	4641667.
73	20	2419.	47	1436	1450	15.	0.2220506D-04	0.1455	4641667.	1.00	4641667.

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

Exp.	Tr.	Dose	Jug	Isolates		Purples					
73	20	2419.	97	1451	1460	10.	0.1917803D-04	0.1123	4641667.	1.00	4641667.
73	20	2419.	101	1461	1480	20.	0.3725464D-04	0.1157	4641667.	1.00	4641667.
73	20	2419.	134	1481	1497	17.	0.2722963D-04	0.1345	4641667.	1.00	4641667.
73	20	2419.	178	1493	1507	10.	0.2134438D-04	0.1246	4641667.	0.81	3759750.
73	7	2072.	28	1601	1616	16.	0.2742418D-04	0.1420	4108333.	1.00	4108333.
73	7	2072.	60	1617	1630	14.	0.2092621D-04	0.1628	4108333.	1.00	4108333.
73	7	2072.	61	1631	1651	21.	0.3404007D-04	0.1502	4108333.	1.00	4108333.
73	7	2072.	88	1652	1666	15.	0.3593962D-04	0.1016	4108333.	1.00	4108333.
73	7	2072.	114	1667	1681	15.	0.2912395D-04	0.1254	4108333.	1.00	4108333.
73	7	2072.	121	1682	1693	12.	0.2513861D-04	0.1162	4108333.	1.00	4108333.
73	7	2072.	154	1694	1699	6.	0.1283262D-04	0.1138	4108333.	1.00	4108333.
73	7	2072.	162	1700	1710	11.	0.4319372D-04	0.1512	4108333.	0.41	1684417.
73	8	1679.	18	1801	1818	18.	0.3317748D-04	0.1208	4491667.	1.00	4491667.
73	8	1679.	31	1819	1834	16.	0.2521671D-04	0.1413	4491667.	1.00	4491667.
73	8	1679.	44	1835	1845	11.	0.1639039D-04	0.1494	4491667.	1.00	4491667.
73	8	1679.	78	1846	1856	11.	0.1414556D-04	0.1731	4491667.	1.00	4491667.
73	8	1679.	82	1857	1870	14.	0.3341688D-04	0.0933	4491667.	1.00	4491667.
73	8	1679.	142	1871	1879	9.	0.1817447D-04	0.1102	4491667.	1.00	4491667.
73	8	1679.	170	1880	1885	6.	0.2131092D-04	0.0895	4491667.	0.70	3144167.

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 3

NUMBER OF JUGS	24.	
MEAN JUG VOLUME	9610.42	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.0
MEAN CONIDIA PER JUG		0.43868056D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	4	
LAST ISOLATE	10	
BACKGROUND MEAN	3925.17	
CSS		0.94566473D 07
VAR. MEAN		0.17131607D 05
PURPLE MUTANT MEAN	0.29	
CSS		0.49583333D 01
VAR. MEAN		0.89824879D-02
MUTANT/SURVIVOR		0.48099684D-06
VARIANCE		0.25311977D-13
S.E.		0.15909734D-06
CI	0.48099684D-06	0.48099684D-06
C.V.		0.33076588D 02
SURVIVAL FRACTION		0.14396386D 00
VARIANCE		0.26749663D-04
S.E.		0.51720031D-02
CI	0.14396386D 00	0.14396386D 00
C.V.		0.35925704D 01
SURVIVAL RATIO	1.00000000	
VARIANCE		0.0
S.E.		0.0
CI	0.10000000D 01	0.10000000D 01
C.V.		0.0

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 24

NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9432.14	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.59700000D 03
MEAN CONIDIA PER JUG		0.36804762D 07
VOLUME INOCULATED	1.87	
FIRST ISOLATE	4601	
LAST ISOLATE	4622	
BACKGROUND MEAN	3447.29	
CSS		0.29008514D 07
VAR. MEAN		0.69067891D 05
PURPLE MUTANT MEAN	3.14	
CSS		0.26857143D 02
VAR. MEAN		0.63945578D 00
MUTANT/SURVIVOR		0.55797528D-05
VARIANCE		0.15431744D-11
S.E.		0.12422452D-05
CI	0.28455706D-05	0.83139349D-05
C.V.		0.22263444D 02
SURVIVAL FRACTION		0.14733300D 00
VARIANCE		0.25909847D-04
S.E.		0.50901696D-02
CI	0.13612953D 00	0.15853646D 00
C.V.		0.34548742D 01
SURVIVAL RATIO	1.02340264	
VARIANCE		0.26019128D-02
S.E.		0.51008947D-01
CI	0.10924933D 08	-0.10924931D 08
C.V.		0.49842501D 01

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 21

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9525.00	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.13530000D 04
MEAN CONIDIA PER JUG		0.37194375D 07
VOLUME INOCULATED	0.93	
FIRST ISOLATE 4001		
LAST ISOLATE 4062		
BACKGROUND MEAN	3019.87	
CSS		0.47581849D 07
VAR. MEAN		0.84967587D 05
PURPLE MUTANT MEAN	7.75	
CSS		0.97500000D 02
VAR. MEAN		0.17410714D 01
MUTANT/SURVIVOR		0.17318637D-04
VARIANCE		0.92904947D-11
S.E.		0.30480305D-05
CI	0.10734891D-04	0.23902384D-04
C.V.		0.17599713D 02
SURVIVAL FRACTION		0.12797706D 00
VARIANCE		0.49153558D-04
S.E.		0.70109554D-02
CI	0.11283339D 00	0.14312072D 00
C.V.		0.54782908D 01
SURVIVAL RATIO	0.88895266	
VARIANCE		0.33915616D-02
S.E.		0.58237117D-01
CI	-0.13114034D 16	0.13114034D 16
C.V.		0.65512056D 01

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 22

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9603.12	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.10840000D 04
MEAN CONIDIA PER JUG		0.36943542D 07
VOLUME INOCULATED	0.96	
FIRST ISOLATE 4201		
LAST ISOLATE 4260		
BACKGROUND MEAN	3276.62	
CSS		0.34572319D 07
VAR. MEAN		0.61736283D 05
PURPLE MUTANT MEAN	7.50	
CSS		0.18000000D 02
VAR. MEAN		0.32142857D 00
MUTANT/SURVIVOR		0.15336100D-04
VARIANCE		0.50797952D-11
S.E.		0.22538397D-05
CI	0.10467806D-04	0.20204394D-04
C.V.		0.14696303D 02
SURVIVAL FRACTION		0.14120106D 00
VARIANCE		0.53006880D-04
S.E.		0.72805807D-02
CI	0.12547500D 00	0.15692711D 00
C.V.		0.51561801D 01
SURVIVAL RATIO	0.98080903	
VARIANCE		0.37991525D-02
S.E.		0.61637264D-01
CI	-0.13879690D 16	0.13879690D 16
C.V.		0.62843287D 01

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 23

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9562.50	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.89000000D 03
MEAN CONIDIA PER JUG		0.37308333D 07
VOLUME INOCULATED	0.92	
FIRST ISOLATE	4401	
LAST ISOLATE	4444	
BACKGROUND MEAN	3302.25	
CSS		0.63421555D 07
VAR. MEAN		0.11325278D 06
PURPLE MUTANT MEAN	5.50	
CSS		0.10000000D 02
VAR. MEAN		0.17857143D 00
MUTANT/SURVIVOR		0.12080230D-04
VARIANCE		0.77221009D-11
S.E.		0.27788665D-05
CI	0.60778778D-05	0.18082581D-04
C.V.		0.23003424D 02
SURVIVAL FRACTION		0.14064580D 00
VARIANCE		0.56313029D-04
S.E.		0.75041987D-02
CI	0.12443673D 00	0.15685487D 00
C.V.		0.53355298D 01
SURVIVAL RATIO	0.97695215	
VARIANCE		0.39489271D-02
S.E.		0.62840462D-01
CI	-0.14150631D 16	0.14150631D 16
C.V.		0.64322968D 01

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 9

NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9492.86	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.31360000D 04
MEAN CONIDIA PER JUG		0.39630714D 07
VOLUME INOCULATED	0.97	
FIRST ISOLATE	3000	
LAST ISOLATE	3145	
BACKGROUND MEAN	3050.71	
CSS		0.23931434D 07
VAR. MEAN		0.56979605D 05
PURPLE MUTANT MEAN	20.86	
CSS		0.31485714D 03
VAR. MEAN		0.74965986D 01
MUTANT/SURVIVOR		0.44657441D-04
VARIANCE		0.51918700D-10
S.E.		0.72054618D-05
CI	0.28798216D-04	0.60516665D-04
C.V.		0.16134964D 02
SURVIVAL FRACTION		0.12146051D 00
VARIANCE		0.56292174D-04
S.E.		0.75028092D-02
CI	0.10494682D 00	0.13797419D 00
C.V.		0.61771595D 01
SURVIVAL RATIO	0.84368747	
VARIANCE		0.36347723D-02
S.E.		0.60289074D-01
CI	0.12912520D 08	-0.12912519D 08
C.V.		0.71459013D 01

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 10

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9537.50	
MEAN SAMPLE VOLUME	60.00	
DOSE	0.28640000D 04	
MEAN CONIDIA PER JUG	0.41228125D 07	
VOLUME INOCULATED	0.99	
FIRST ISOLATE	3201	
LAST ISOLATE	3389	
BACKGROUND MEAN	3082.62	
CSS	0.31939839D 07	
VAR. MEAN	0.57035426D 05	
PURPLE MUTANT MEAN	23.62	
CSS	0.46787500D 03	
VAR. MEAN	0.83549107D 01	
MUTANT/SURVIVOR	0.47517438D-04	
VARIANCE	0.14570322D-10	
S.E.	0.38171083D-05	
CI	0.39272484D-04	0.55762393D-04
C.V.	0.80330684D 01	
SURVIVAL FRACTION	0.11836327D 00	
VARIANCE	0.68986844D-04	
S.E.	0.83058290D-02	
CI	0.10042267D 00	0.13630386D 00
C.V.	0.70172355D 01	
SURVIVAL RATIO	0.82217346	
VARIANCE	0.42010277D-02	
S.E.	0.64815283D-01	
CI	-0.14595328D 16	0.14595328D 16
C.V.	0.78834074D 01	

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 25

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9537.50	
MEAN SAMPLE VOLUME	60.00	
DOSE	0.24190000D 04	
MEAN CONIDIA PER JUG	0.39022500D 07	
VOLUME INOCULATED	0.91	
FIRST ISOLATE	3401	
LAST ISOLATE	3544	
BACKGROUND MEAN	3273.62	
CSS	0.63275479D 07	
VAR. MEAN	0.11299193D 06	
PURPLE MUTANT MEAN	18.00	
CSS	0.21200000D 03	
VAR. MEAN	0.37857143D 01	
MUTANT/SURVIVOR	0.35318472D-04	
VARIANCE	0.52543803D-11	
S.E.	0.22922432D-05	
CI	0.30367226D-04	0.40269717D-04
C.V.	0.64902105D 01	
SURVIVAL FRACTION	0.13541984D 00	
VARIANCE	0.33690540D-04	
S.E.	0.58043525D-02	
CI	0.12288244D 00	0.14795724D 00
C.V.	0.42861906D 01	
SURVIVAL RATIO	0.94065163	
VARIANCE	0.27675600D-02	
S.E.	0.52607603D-01	
CI	-0.11846361D 16	0.11846361D 16
C.V.	0.55926766D 01	

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 11

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9625.00	
MEAN SAMPLE VOLUME	60.00	
DOSE	0.20720000D 04	
MEAN CONIDIA PER JUG	0.42166667D 07	
VOLUME INOCULATED	1.00	
FIRST ISOLATE	3601	
LAST ISOLATE	3730	
BACKGROUND MEAN	3437.87	
CSS	0.22851189D 07	
VAR. MEAN	0.40805694D 05	
PURPLE MUTANT MEAN	16.25	
CSS	0.19950000D 03	
VAR. MEAN	0.35625000D 01	
MUTANT/SURVIVOR	0.29550187D-04	
VARIANCE	0.99859951D-11	
S.E.	0.31600621D-05	
CI	0.22724453D-04	0.36375922D-04
C.V.	0.10693882D 02	
SURVIVAL FRACTION	0.13059938D 00	
VARIANCE	0.53824966D-04	
S.E.	0.73365495D-02	
CI	0.11475243D 00	0.14644633D 00
C.V.	0.56175989D 01	
SURVIVAL RATIO	0.90716782	
VARIANCE	0.36591808D-02	
S.E.	0.60491163D-01	
CI	-0.13621608D 16	0.13621608D 16
C.V.	0.66681337D 01	

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 12

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9506.25	
MEAN SAMPLE VOLUME	60.00	
DOSE	0.16790000D 04	
MEAN CONIDIA PER JUG	0.40222500D 07	
VOLUME INOCULATED	0.93	
FIRST ISOLATE	3801	
LAST ISOLATE	3874	
BACKGROUND MEAN	3510.87	
CSS	0.81079409D 07	
VAR. MEAN	0.14478466D 06	
PURPLE MUTANT MEAN	9.25	
CSS	0.79500000D 02	
VAR. MEAN	0.14196429D 01	
MUTANT/SURVIVOR	0.16800120D-04	
VARIANCE	0.18505749D-11	
S.E.	0.13603576D-05	
CI	0.13861748D-04	0.19738493D-04
C.V.	0.80973087D 01	
SURVIVAL FRACTION	0.13732543D 00	
VARIANCE	0.90187583D-04	
S.E.	0.94967112D-02	
CI	0.11681253D 00	0.15783833D 00
C.V.	0.69154789D 01	
SURVIVAL RATIO	0.95388822	
VARIANCE	0.55258816D-02	
S.E.	0.74336231D-01	
CI	-0.16739287D 16	0.16739287D 16
C.V.	0.77929708D 01	

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 1

NUMBER OF JUGS	11.	
MEAN JUG VOLUME	9543.18	
MEAN SAMPLE VOLUME	60.00	
DOSE	0.0	
MEAN CONIDIA PER JUG	0.42265152D 07	
VOLUME INOCULATED	1.00	
FIRST ISOLATE	1	
LAST ISOLATE	3	
BACKGROUND MEAN	3699.64	
CSS	0.43820925D 07	
VAR. MEAN	0.39837205D 05	
PURPLE MUTANT MEAN	0.27	
CSS	0.21818182D 01	
VAR. MEAN	0.19834711D-01	
MUTANT/SURVIVOR	0.49482711D-06	
VARIANCE	0.65609289D-13	
S.E.	0.25614298D-06	
CI 0.0	0.10309345D-05	
C.V.	0.51764137D 02	
SURVIVAL FRACTION	0.13914400D 00	
VARIANCE	0.55979562D-04	
S.E.	0.74819475D-02	
CI 0.12348428D 00	0.15480372D 00	
C.V.	0.53771254D 01	
SURVIVAL RATIO	1.00000000	
VARIANCE	0.0	
S.E.	0.0	
CI 0.10000000D 01	0.10000000D 01	
C.V.	0.0	

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 19

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9537.50	
MEAN SAMPLE VOLUME	60.00	
DOSE	0.59700000D 03	
MEAN CONIDIA PER JUG	0.37957500D 07	
VOLUME INOCULATED	0.94	
FIRST ISOLATE	2601	
LAST ISOLATE	2626	
BACKGROUND MEAN	3361.50	
CSS	0.35914220D 07	
VAR. MEAN	0.64132536D 05	
PURPLE MUTANT MEAN	3.25	
CSS	0.23500000D 02	
VAR. MEAN	0.41964286D 00	
MUTANT/SURVIVOR	0.59202262D-05	
VARIANCE	0.95932794D-12	
S.E.	0.97945212D-06	
CI 0.38046095D-05	0.80358429D-05	
C.V.	0.16544167D 02	
SURVIVAL FRACTION	0.14319196D 00	
VARIANCE	0.11751132D-03	
S.E.	0.10840263D-01	
CI 0.11977699D 00	0.16660693D 00	
C.V.	0.75704410D 01	
SURVIVAL RATIO	1.02909189	
VARIANCE	0.91314952D-02	
S.E.	0.95558822D-01	
CI 0.10290919D 01	0.10290919D 01	
C.V.	0.92857424D 01	

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 16

NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9600.00	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.13530000D 04
MEAN CONIDIA PER JUG		0.45416667D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	2001	
LAST ISOLATE	2066	
BACKGROUND MEAN	3378.14	
CSS		0.22876249D 07
VAR. MEAN		0.54467259D 05
PURPLE MUTANT MEAN	9.43	
CSS		0.69714286D 02
VAR. MEAN		0.16598639D 01
MUTANT/SURVIVOR		0.18006316D-04
VARIANCE		0.71563980D-11
S.E.		0.26751441D-05
CI	0.12118323D-04	0.23894309D-04
C.V.		0.14856698D 02
SURVIVAL FRACTION		0.11887153D 00
VARIANCE		0.61689802D-04
S.E.		0.78542829D-02
CI	0.10158425D 00	0.13615881D 00
C.V.		0.66073707D 01
SURVIVAL RATIO	0.85430584	
VARIANCE		0.52965011D-02
S.E.		0.72777033D-01
CI	0.70875177D 00	0.99985990D 00
C.V.		0.85188500D 01

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 17

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9665.62	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.10840000D 04
MEAN CONIDIA PER JUG		0.43007292D 07
VOLUME INOCULATED	0.97	
FIRST ISOLATE	2026	
LAST ISOLATE	2246	
BACKGROUND MEAN	3271.37	
CSS		0.18424759D 07
VAR. MEAN		0.32901355D 05
PURPLE MUTANT MEAN	5.75	
CSS		0.79500000D 02
VAR. MEAN		0.14196429D 01
MUTANT/SURVIVOR		0.11362208D-04
VARIANCE		0.72504537D-11
S.E.		0.26926664D-05
CI	0.55460481D-05	0.17178367D-04
C.V.		0.23698444D 02
SURVIVAL FRACTION		0.12300543D 00
VARIANCE		0.48589930D-04
S.E.		0.69706440D-02
CI	0.10794884D 00	0.13806202D 00
C.V.		0.56669401D 01
SURVIVAL RATIO	0.88401532	
VARIANCE		0.47692142D-02
S.E.		0.69059491D-01
CI	0.88401532D 00	0.88401532D 00
C.V.		0.78120242D 01

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 18

NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9546.43	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.89000000D 03
MEAN CONIDIA PER JUG		0.43333333D 07
VOLUME INOCULATED	1.00	
FIRST ISOLATE	2401	
LAST ISOLATE	2430	
BACKGROUND MEAN	3603.00	
CSS		0.15391060D 07
VAR. MEAN		0.36645381D 05
PURPLE MUTANT MEAN	4.29	
CSS		0.43428571D 02
VAR. MEAN		0.10340136D 01
MUTANT/SURVIVOR		0.75945271D-05
VARIANCE		0.29944138D-11
S.E.		0.17304374D-05
CI	0.37858336D-05	0.11403220D-04
C.V.		0.22785321D 02
SURVIVAL FRACTION		0.13238897D 00
VARIANCE		0.53801279D-04
S.E.		0.73349327D-02
CI	0.11624478D 00	0.14853316D 00
C.V.		0.55404409D 01
SURVIVAL RATIO	0.95145294	
VARIANCE		0.53962709D-02
S.E.		0.73459268D-01
CI	0.80453440D 00	0.10983715D 01
C.V.		0.77207463D 01

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 5

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9468.75	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.31360000D 04
MEAN CONIDIA PER JUG		0.41839583D 07
VOLUME INOCULATED	0.94	
FIRST ISOLATE	1000	
LAST ISOLATE	1159	
BACKGROUND MEAN	2824.75	
CSS		0.26988655D 07
VAR. MEAN		0.48194027D 05
PURPLE MUTANT MEAN	20.00	
CSS		0.29200000D 03
VAR. MEAN		0.52142857D 01
MUTANT/SURVIVOR		0.45944865D-04
VARIANCE		0.26972134D-10
S.E.		0.51934703D-05
CI	0.34726969D-04	0.57162762D-04
C.V.		0.11303701D 02
SURVIVAL FRACTION		0.10664225D 00
VARIANCE		0.25101413D-04
S.E.		0.50101280D-02
CI	0.95820371D-01	0.11746413D 00
C.V.		0.46980705D 01
SURVIVAL RATIO	0.76641642	
VARIANCE		0.29948515D-02
S.E.		0.54725237D-01
CI	0.76641642D 00	0.76641642D 00
C.V.		0.71404051D 01

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 6

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9543.75	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.28640000D 04
MEAN CONIDIA PER JUG		0.40076042D 07
VOLUME INOCULATED	0.99	
FIRST ISOLATE	1201	
LAST ISOLATE	1338	
BACKGROUND MEAN	3339.00	
CSS		0.20618640D 07
VAR. MEAN		0.36819000D 05
PURPLE MUTANT MEAN	17.25	
CSS		0.23950000D 03
VAR. MEAN		0.42767857D 01
MUTANT/SURVIVOR		0.31817232D-04
VARIANCE		0.58261610D-11
S.E.		0.24137435D-05
CI	0.26603546D-04	0.37030918D-04
C.V.		0.75862773D 01
SURVIVAL FRACTION		0.13237675D 00
VARIANCE		0.50136084D-04
S.E.		0.70806816D-02
CI	0.11708248D 00	0.14767103D 00
C.V.		0.53488860D 01
SURVIVAL RATIO	0.95136515	
VARIANCE		0.52064802D-02
S.E.		0.72155893D-01
CI	0.95136515D 00	0.95136515D 00
C.V.		0.75844583D 01

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 20

NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9607.14	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.24190000D 04
MEAN CONIDIA PER JUG		0.45156786D 07
VOLUME INOCULATED	0.97	
FIRST ISOLATE	1401	
LAST ISOLATE	1507	
BACKGROUND MEAN	3620.57	
CSS		0.10371057D 07
VAR. MEAN		0.24692993D 05
PURPLE MUTANT MEAN	15.29	
CSS		0.91428571D 02
VAR. MEAN		0.21768707D 01
MUTANT/SURVIVOR		0.26273949D-04
VARIANCE		0.52855247D-11
S.E.		0.22990262D-05
CI	0.21213791D-04	0.31334106D-04
C.V.		0.87502119D 01
SURVIVAL FRACTION		0.12836371D 00
VARIANCE		0.19274435D-04
S.E.		0.43902621D-02
CI	0.11870074D 00	0.13802668D 00
C.V.		0.34201738D 01
SURVIVAL RATIO	0.92252423	
VARIANCE		0.34562115D-02
S.E.		0.58789551D-01
CI	0.80494513D 00	0.10401033D 01
C.V.		0.63726837D 01

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 7

NUMBER OF JUGS	8.	
MEAN JUG VOLUME	9612.50	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.20720000D 04
MEAN CONIDIA PER JUG		0.38053437D 07
VOLUME INOCULATED	0.93	
FIRST ISOLATE	1601	
LAST ISOLATE	1710	
BACKGROUND MEAN	3134.87	
CSS		0.51217529D 07
VAR. MEAN		0.91459873D 05
PURPLE MUTANT MEAN	13.75	
CSS		0.13150000D 03
VAR. MEAN		0.23482143D 01
MUTANT/SURVIVOR		0.28577373D-04
VARIANCE		0.11028079D-10
S.E.		0.33208544D-05
CI	0.21404328D-04	0.35750419D-04
C.V.		0.11620572D 02
SURVIVAL FRACTION		0.13289515D 00
VARIANCE		0.58802926D-04
S.E.		0.76683052D-02
CI	0.11633161D 00	0.14945869D 00
C.V.		0.57701918D 01
SURVIVAL RATIO	0.95509078	
VARIANCE		0.56746599D-02
S.E.		0.75330257D-01
CI	0.95509078D 00	0.95509078D 00
C.V.		0.78872353D 01

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73 TREATMENT 8

NUMBER OF JUGS	7.	
MEAN JUG VOLUME	9635.71	
MEAN SAMPLE VOLUME	60.00	
DOSE		0.16790000D 04
MEAN CONIDIA PER JUG		0.42991667D 07
VOLUME INOCULATED	0.96	
FIRST ISOLATE	1801	
LAST ISOLATE	1885	
BACKGROUND MEAN	3407.57	
CSS		0.66476677D 07
VAR. MEAN		0.15827780D 06
PURPLE MUTANT MEAN	12.14	
CSS		0.10285714D 03
VAR. MEAN		0.24489796D 01
MUTANT/SURVIVOR		0.23118315D-04
VARIANCE		0.86936660D-11
S.E.		0.29485018D-05
CI	0.16629261D-04	0.29608569D-04
C.V.		0.12753634D 02
SURVIVAL FRACTION		0.12537978D 00
VARIANCE		0.13511337D-03
S.E.		0.11623826D-01
CI	0.99795731D-01	0.15096382D 00
C.V.		0.92708937D 01
SURVIVAL RATIO	0.90107928	
VARIANCE		0.93262297D-02
S.E.		0.96572340D-01
CI	0.70793460D 00	0.10942240D 01
C.V.		0.10717408D 02

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73

WEIGHTED REGRESSION ANALYSIS LOG MUTANTS ON LOG DOSE

NUMBER OF X= 9. NUMBER OF JUGS= 68.

X TOTAL= 0.50074679D 03 X MEAN= 0.73639234D 01

Y TOTAL= -0.74137327D 03 Y MEAN= -0.10902548D 02

XSS= 0.37071223D 04 XCSS= 0.19661315D 02 REC = 0.50861298D-01

XYSS= -0.54358163D 04 XYCSS= 0.23599661D 02

YSS= 0.81123912D 04 YCSS= 0.29533500D 02

REDUCTION SS= 28.32689593

RESIDUAL SS= 1.20660378

RESIDUAL MEAN SQUARE= 0.17237197

F= 164.33586140 WITH 1 AND 7 DEGREES OF FREEDOM

STANDARD ERROR OF SLOPE= 0.93632579D-01

CONSTANT = 0.26690816D-08 SLOPE= 0.12003094D 01PLUS OR MINUS 0.20224638D 00 95 PER CENT CONFIDENCE INTERVAL

OBSERVED		EXPECTED
DOSE	MR	MR
0.597000D 03	0.592023D-05	0.573309D-05
0.135300D 04	0.180063D-04	0.153069D-04
0.108400D 04	0.113622D-04	0.117310D-04
0.890000D 03	0.759453D-05	0.925852D-05
0.313600D 04	0.459449D-04	0.419850D-04
0.286400D 04	0.318172D-04	0.376529D-04
0.241900D 04	0.262739D-04	0.307447D-04
0.207200D 04	0.285774D-04	0.255302D-04
0.167900D 04	0.231189D-04	0.198344D-04

BIOSATELLITE GROUND CONTROL CAF+LIE+CONRAD DOSIMETRY

EXPERIMENT 73

WEIGHTED REGRESSION ANALYSIS LOG MUTANTS ON LOG DOSE

NUMBER OF X= 9. NUMBER OF JUGS= 70.

X TOTAL= 0.51552254D 03 X MEAN= 0.73646076D 01

Y TOTAL= -0.75480631D 03 Y MEAN= -0.10782947D 02

XSS= 0.38154040D 04 XCSS= 0.18782810D 02 REC = 0.53240171D-01

XYSS= -0.55361878D 04 XYCSS= 0.22664512D 02

YSS= 0.81676697D 04 YCSS= 0.28633090D 02

REDUCTION SS= 27.34841655

RESIDUAL SS= 1.28467373

RESIDUAL MEAN SQUARE= 0.18352482

F= 149.01753743 WITH 1 AND 7 DEGREES OF FREEDOM

STANDARD ERROR OF SLOPE= 0.98847806D-03

CONSTANT = 0.28683169D-08 SLOPE= 0.12066625D 01PLUS OR MINUS 0.21351127D 00 95 PER CENT CONFIDENCE INTERVAL

OBSERVED		EXPECTED
DOSE	MR	MR
0.597000D 03	0.557975D-05	0.641639D-05
0.135300D 04	0.173186D-04	0.172205D-04
0.108400D 04	0.153361D-04	0.131790D-04
0.890000D 03	0.120802D-04	0.103883D-04
0.313600D 04	0.446574D-04	0.474867D-04
0.286400D 04	0.475174D-04	0.425624D-04
0.241900D 04	0.353185D-04	0.347163D-04
0.207200D 04	0.295502D-04	0.287998D-04
0.167900D 04	0.168001D-04	0.223447D-04

BIOSATELLITE FLIGHT CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73

WEIGHTED REGRESSION ANALYSIS LOG SURVIVAL RATIO ON DOSE

NUMBER OF X= 9. NUMBER OF JUGS= 68.

X TOTAL= 0.12241100D 06 X MEAN= 0.18001618D 04

Y TOTAL= -0.63957643D 01 Y MEAN= -0.94055364D-01

XSS= 0.26994630D 09 XCSS= 0.49586703D 08 REC = 0.37044404D-08

XYSS= -0.13901384D 05 XYCSS= -0.23879726D 04

YSS= 0.10434894D 01 YCSS= 0.44193341D 00

REDUCTION SS= 0.71587744

RESIDUAL SS= 0.32761195

RESIDUAL MEAN SQUARE= 0.04680171

F= 15.29596848 WITH 1 AND 8 DEGREES OF FREEDOM

STANDARD ERROR OF SLOPE= 0.13167161D-04

CONSTANT = 0.10000000D 01 SLOPE= -0.51496848D-04PLUS OR MINUS 0.28059218D-04 95 PER CENT CONFIDENCE INTERVAL

OBSERVED		EXPECTED
DOSE	S	S
0.597000D 03	0.102909D 01	0.969724D 00
0.135300D 04	0.854306D 00	0.932697D 00
0.108400D 04	0.884015D 00	0.945707D 00
0.890000D 03	0.951453D 00	0.955202D 00
0.313600D 04	0.766416D 00	0.850872D 00
0.286400D 04	0.951365D 00	0.862874D 00
0.241900D 04	0.922524D 00	0.882876D 00
0.207200D 04	0.955091D 00	0.898794D 00
0.167900D 04	0.901079D 00	0.917169D 00

BIOSATELLITE GROUND CONTROL CAF+LIF+CONRAD DOSIMETRY

EXPERIMENT 73

WEIGHTED REGRESSION ANALYSIS LOG SURVIVAL RATIO ON DOSE

NUMBER OF X= 9. NUMBER OF JUGS= 70.

X TOTAL= 0.12501900D 06 X MEAN= 0.17859857D 04

Y TOTAL= -0.55241210D 01 Y MEAN= -0.78916014D-01

XSS= 0.27104871D 09 XCSS= 0.47766563D 08 REC = 0.36893738D-08

XYSS= -0.13162088D 05 XYCSS= -0.32960864D 04

YSS= 0.75461003D 00 YCSS= 0.31866842D 00

REDUCTION SS= 0.63914913

RESIDUAL SS= 0.11546089

RESIDUAL MEAN SQUARE= 0.01649441

F= 38.74943190 WITH 1 AND 8 DEGREES OF FREEDOM

STANDARD ERROR OF SLOPE= 0.78008998D-05

'CONSTANT = 0.10000000D 01 SLOPE= -0.48559860D-04PLUS OR MINUS 0.16623716D-04 95 PER CENT CONFIDENCE INTERVAL'

OBSERVED		EXPECTED
DOSE	S	S
0.5970000D 03	0.102340D 01	0.971426D 00
0.1353000D 04	0.888953D 00	0.936410D 00
0.1084000D 04	0.980809D 00	0.948723D 00
0.8900000D 03	0.976952D 00	0.957702D 00
0.3136000D 04	0.843687D 00	0.858745D 00
0.2864000D 04	0.822173D 00	0.870162D 00
0.2419000D 04	0.940652D 00	0.889171D 00
0.2072000D 04	0.907168D 00	0.904280D 00
0.1679000D 04	0.953888D 00	0.921703D 00

V. ASSAYS WITH UNIRRADIATED CONIDIA

Samples of unirradiated conidia were assayed for heterokaryotic survival and forward-mutation frequency in the ad-3 region after the following three types of treatment: (1) incubation in the aft compartment of the ground-control vehicle at a temperature of 72° F; (2) incubation in the aft compartment of the flight vehicle (subjected to flight accelerations and vibrations) at a temperature of about 64-66° F; (3) incubation in one of three different controlled temperature incubators operating in the temperature range of 64-72° F. The data from the various ground-control samples of unirradiated conidia can be used as a basis of comparison to ascertain the effect of flight alone on the unirradiated conidia in the aft compartment of the flight vehicle. The appropriate data are taken from the print-outs and summarized in Table 4. The heterokaryotic survival estimates and ad-3 mutation frequencies in the flight samples are not different from the comparable ground-control samples. Furthermore, the flight samples exhibit the same ad-3 mutation frequency (0.5×10^{-6}) as have been obtained from control conidia (not subjected to a mutagenic treatment) in a large number of experiments in the laboratory (ca. 0.4×10^{-6}). It is concluded that there is no detectable effect of flight by itself upon the survival of heterokaryotic conidia and none upon frequency of specific locus mutations in the ad-3 region.

Table 4. Results of assays with unirradiated conidia

Sample Location	Treatment Numbers	Average Heterokaryotic Surviving Proportion		ad-3 Mutants	Colonies Tested	ad-3 Mutation Frequency
		Plate Data	Flask Data			
Ground-Control Vehicle	3, 4	0.1688	0.1332	2	7, 250, 756	0.3×10^{-6}
Ground-Control Incubators	13, 14, 15	0.1744	0.1550	4	7, 825, 941	0.6×10^{-6}
Flight Vehicle	1, 2	0.1756	0.1391	3	6, 467, 852	0.5×10^{-6}

VI. DOSE-RESPONSE CURVES FOR SURVIVAL OF IRRADIATED CONIDIA ASSAYED IN LIQUID MEDIUM

In previous experiments with ionizing radiation at low dose rates, but with higher total doses, the heterokaryotic survival estimates from assays involving liquid medium were about 70% of the unirradiated controls after exposure to 20,000 Roentgens, about 82% after 10,000 Roentgens, and about 92% after 5000 Roentgens. In the Biosatellite II experiment, where the maximum exposure is estimated to be 3136 Roentgens, it is not surprising that the total effect on heterokaryotic survival should be a small one. In the print-outs on pp. 55 and 56 the estimates of the slopes of the survival curves (logarithm of percent survival vs. exposure) are shown for ground-control samples and for flight samples, respectively. In both cases, the slopes are different from zero (at 95% confidence level) but are not different from each other. In Figs. 7 and 8, a plot of the estimates of heterokaryotic surviving proportion for ground-control and flight samples, respectively, with the regression line transposed to the different position on the graph (from 100% at zero dose to 0.1440 or to 0.1391) will give some indication of dispersion about the line. There appears to be no detectable difference between flight and ground-control samples with respect to nuclear inactivation as assayed in liquid culture.

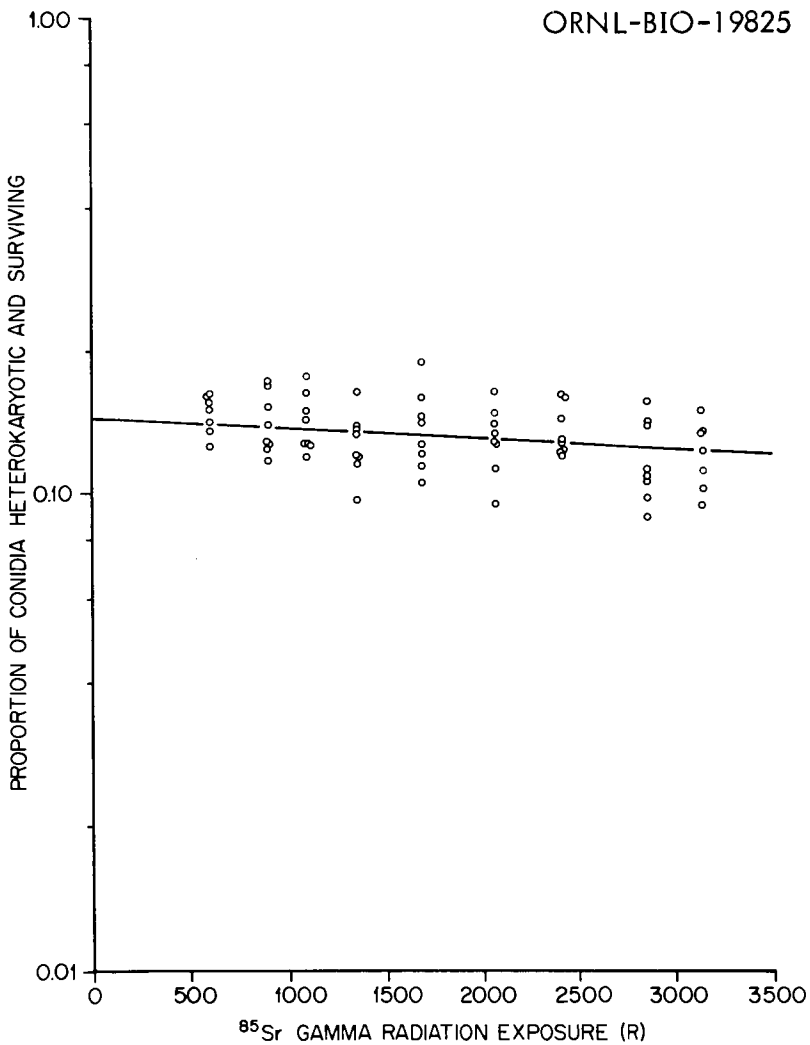

Fig. 7. Survival of Heterokaryotic Conidia in the Ground-Control Vehicle

Estimates (based on assays in liquid medium) of proportion of heterokaryotic and viable conidia from the ground-control vehicle plotted on a logarithmic scale against ^{85}Sr gamma radiation exposure on a linear scale. Each point represents the estimate from a single assay flask (jug), except the zero dose estimate which is the mean of data from 24 jugs.

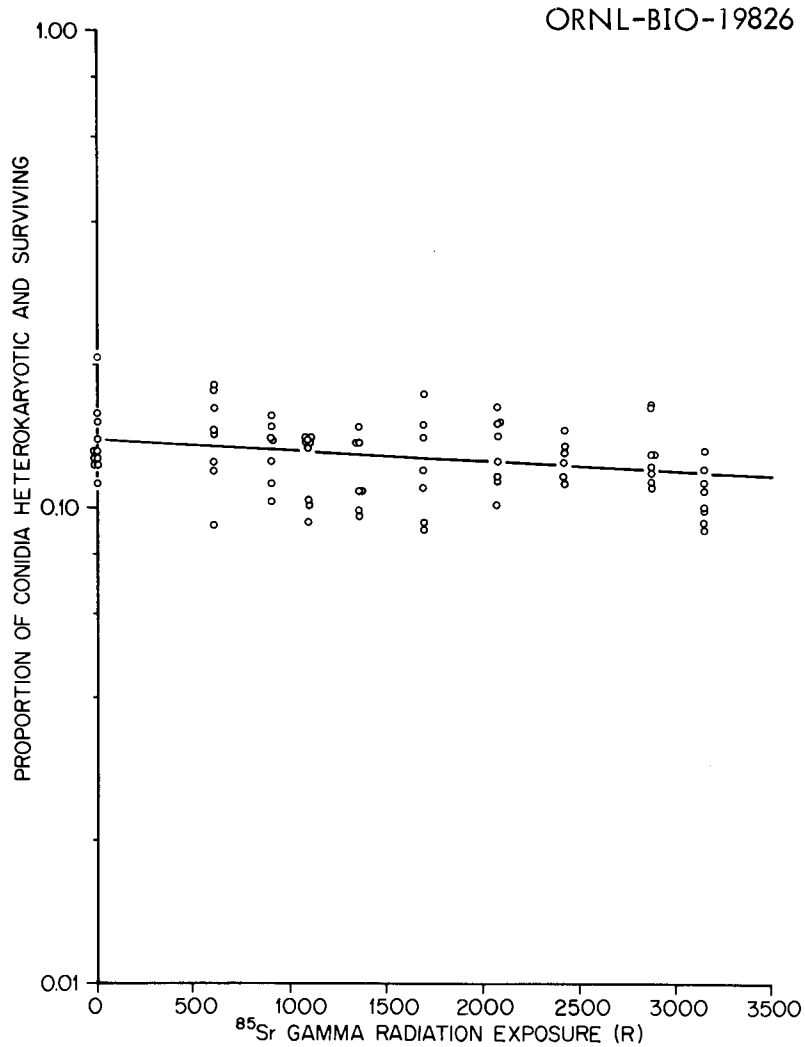

Fig. 8. Survival of Heterokaryotic Conidia from the Flight Vehicle

Estimates (based on assays in liquid medium) of proportion of heterokaryotic and viable conidia from the flight vehicle plotted on a logarithmic scale against ^{85}Sr gamma radiation exposure on a linear scale. Each point represents the estimate from a single assay flask (jug).

VII. DOSE-RESPONSE CURVES FOR SPECIFIC LOCUS MUTATIONS IN THE ad-3 REGION

The estimated frequency of gamma-radiation-induced specific locus mutations in the ad-3 region for each dose point is plotted for the conidia from the flight vehicle (Fig. 9) and from the ground control vehicle (Fig. 10), and the estimated regression line is included in each figure. Visual inspection of the plots and consideration of the slopes with standard errors of the regression lines in these log-log plots (1.2003 ± 0.0936 for flight, and 1.2067 ± 0.0988 for the ground-control vehicle) indicate that there is no detectable effect attributable to the accelerations, vibrations, and weightlessness occurring in orbital flight upon the induction of specific locus mutations in the ad-3 region. After mutants are obtained from such an experiment, they are subjected to a series of tests designed to classify them as resulting from point mutations or multilocus deletions. The genetic analysis is not complete until this classification has been made. It is possible to obtain marked differences in the spectrum of mutations without marked differences in the overall induction curves. When these genetic tests have been completed, it will be possible to determine whether the spectrum of mutant types is the same or different in the flight and ground-control samples.

VIII. INDUCTION OF RECESSIVE LETHAL MUTATIONS IN THE GENERAL POPULATION

Conidia from the aft compartments (unirradiated) and from three different radiation exposures in the forward compartments of both the flight vehicle and the ground-control vehicle were plated in minimal medium so that only heterokaryotic conidia would be detected as colonies. About 200 colonies from each group were isolated onto slants

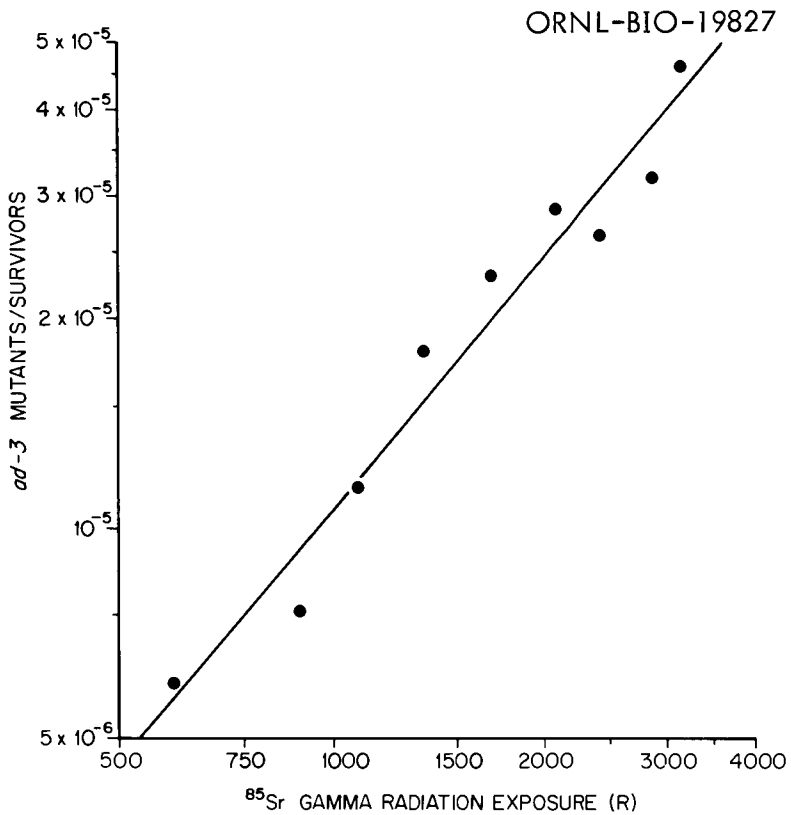

Fig. 9. ad-3 Mutation Frequency in Conidia from the Flight Vehicle

Estimated frequency of specific locus mutations in the ad-3 region induced in conidia from the flight vehicle, plotted on a logarithmic scale against logarithm of gamma radiation exposure.

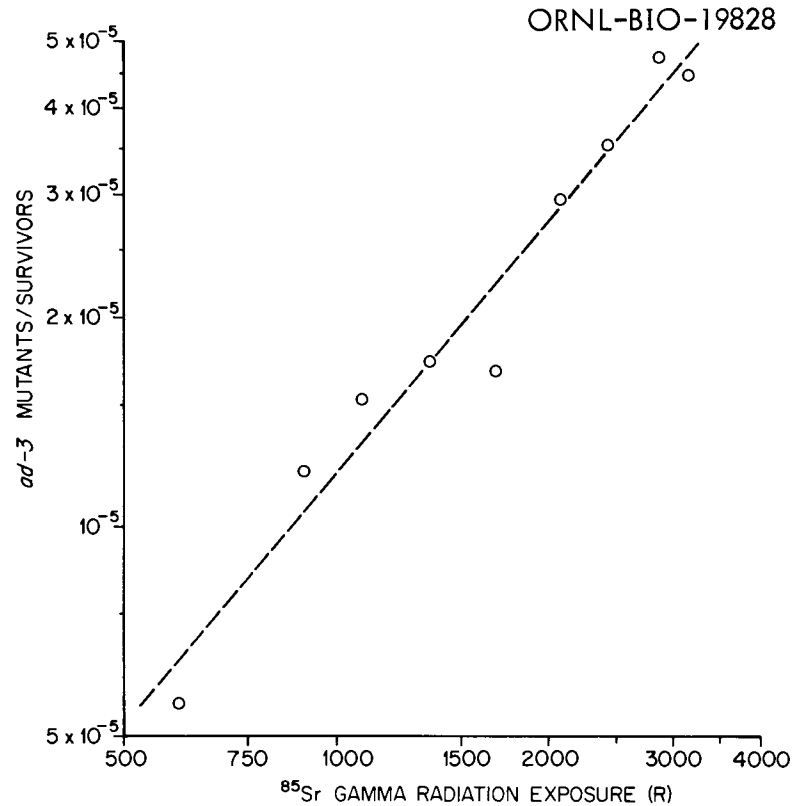

Fig. 10. ad-3 Mutation Frequency in Conidia from the Ground-Control Vehicle

Estimated frequency of specific locus mutation in the ad-3 region induced in conidia from the ground-control vehicle, plotted on a logarithmic scale against logarithm of gamma radiation exposure.

of minimal medium and allowed to form cultures and conidia. Conidia from each culture were then plated in medium supplemented with pantothenic acid, and the plates were incubated at 35° C so that colonies were formed. Each plate was examined for colonies homokaryotic for component 2, i.e., homokaryotic for the cot marker and therefore colonial in morphology at 35° C. The absence of cot colonies was attributed to the presence of a recessive lethal mutant site in the original heterokaryotic conidium from which the colony in the minimal medium was derived. The results from such tests for conidia from the flight and control vehicles subjected to gamma radiation exposures of 0, 890, 2072, and 3136 Roentgens are shown in Table 5. There is no obvious difference between comparable samples from the different vehicles.

The detection of 4.0 and 6.5% recessive lethal mutations in the two unirradiated samples was unexpected and subjected to further examination. Cultures of 21 strains containing such recessive lethal mutations were cultured in all possible combinations in pairs, and the resulting trikaryotic cultures were plated to see whether in each such culture the recessive lethal mutations in each strain were identical or different. Among the 13 recessive lethal mutations from the flight vehicle, 12 of the recessive lethal mutants were identical by this test and the 13th was different. Among the unirradiated conidia from the ground-control vehicle, there were seven identical and one different recessive lethal mutant present. Such results indicate that a high background of identical recessive lethal mutations arose in the population during the growth of the cultures from which the conidia were harvested several days before the flight.

Tests are in progress to adjust the remaining data for preexisting recessive lethal mutations of spontaneous origin. Even in the absence of these data, it seems likely that the increase in recessive lethals from about 5% in the unirradiated samples to about 9% in the 3136 Roentgen samples is due to induced recessive lethals. However, this has not as yet been verified by direct trikaryon tests. The difference between

Table 5. The effect of gamma radiation upon the incidence of recessive lethal mutants in the heterokaryotic conidial population in both the flight and ground-control vehicles

Treatment Number	Test Position	Gamma Radiation Exposure (Roentgens)	Conidia Tested	Conidia Carrying Recessive Lethals	Percent Recessive Lethals
1	Flight vehicle - aft	Unirradiated	200	13	6.5
3	Control vehicle - aft	Unirradiated	199	8	4.0
18	Flight vehicle - fore	890	199	9	4.5
23	Control vehicle - fore	890	176	9	5.1
7	Flight vehicle - fore	2072	199	14	7.0
11	Control vehicle - fore	2072	199	13	6.5
5	Flight vehicle - fore	3136	198	20	10.1
9	Control vehicle - fore	3136	199	17	8.5

pairs of samples receiving the same gamma radiation exposure in the flight and ground-control vehicle is not statistically significant. Thus we have tentatively concluded that the effect of gamma radiation in flight, as indicated by incidence of recessive lethal mutations, is not different from that in the ground-control vehicle.

IX. SUMMARY

The assays completed thus far with conidia from heterokaryotic cultures of Neurospora crassa fail to reveal a difference between those conidia subjected to orbital flight and exposed to gamma radiation in the weightless condition and those conidia similarly irradiated in a duplicate vehicle on the ground under normal gravity conditions. The assays provide estimates of survival of each type of conidia obtained in a heterokaryotic culture, estimates of the incidence of specific locus mutations in the ad-3 region among surviving heterokaryotic conidia, and estimates of the incidence of recessive lethal mutations among the surviving heterokaryotic conidia. The results with specific locus mutations must be considered tentative pending the completion of tests permitting the classification of mutants and estimation of the incidence of ad-3 mutants from each of the different distinguishable classes.

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SECTION 3

BIOLOGY DIVISION

HABROBRACON EXPERIMENT P-1079

QUARTERLY PROGRESS REPORT

TO THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

JULY 1 — SEPTEMBER 30, 1967

(Printed separately as ORNL-TM-2311)

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

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

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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.

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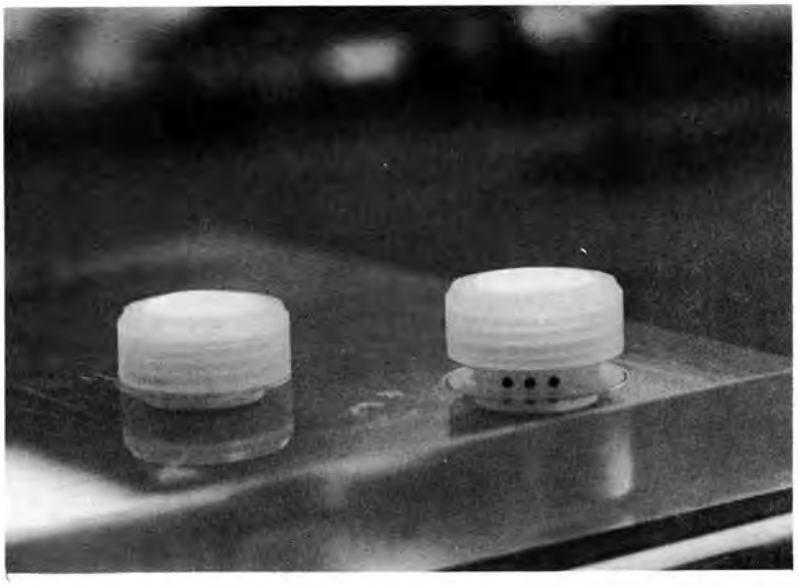

Fig. 1. Modules with the Cap Tightened (on the left) and the Cap Sitting Loosely in Place (on the right). The Three Holes Beneath the Cap on the Module on the Right Have the Glass Rods and Plastic Inserts in Place.

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, CoF_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.

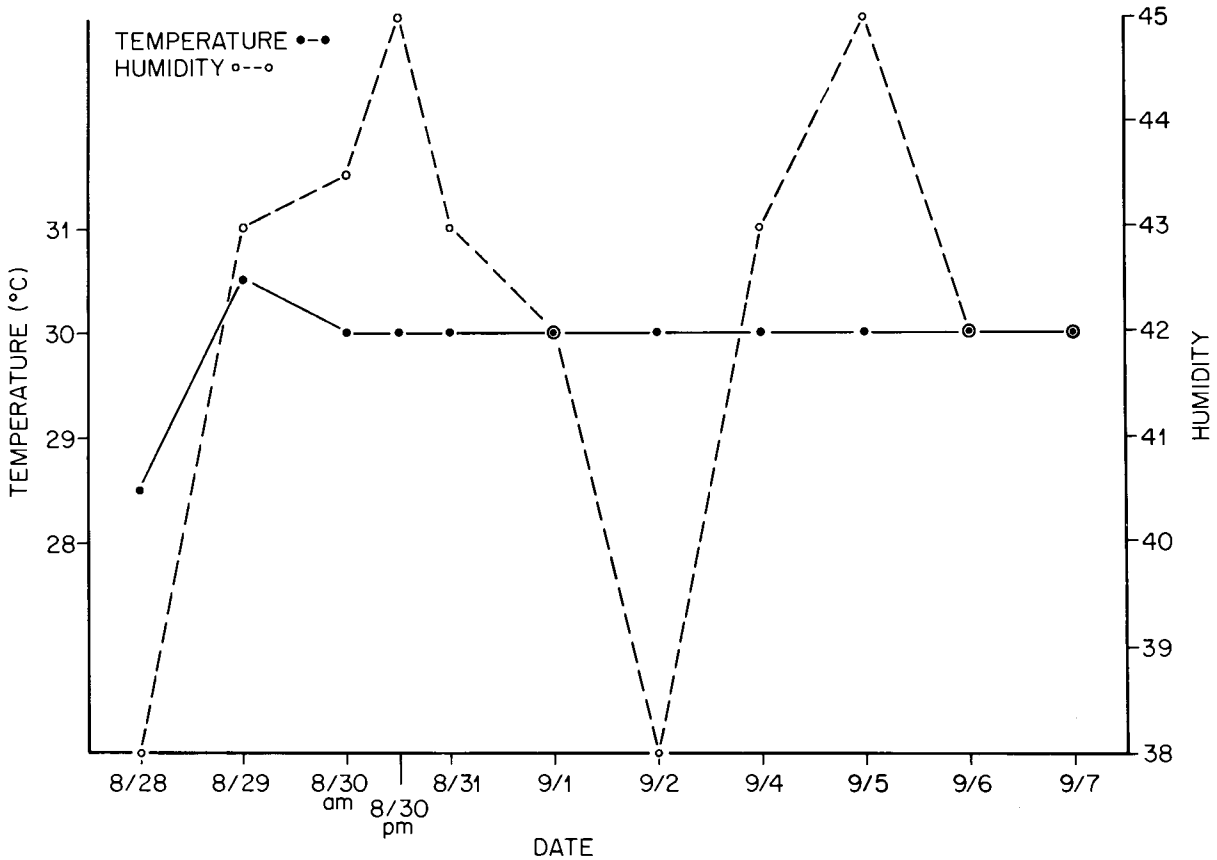

Fig. 4. Temperature and Humidity Record of Constant Temperature Room at the University of Hawaii.

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.

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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).

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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

Biosatellite Flight 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. R. Baird~~
M. L. Pardue

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	RK

CHECKLIST: FLIGHT

Attachment of Radiation Shields

Torque : 24 ± 2% in. lbs.

Date:

Programmed time: Start T - 625
Finish T - 610

Actual time: Start 0400
Finish 0425

Package	Time	Initials
1	0400	
2		
3		
4		
C	******	*******
Sp1		
Sp2	0425	RB
SpC	******	*******

Biosatellite Flight B

CHECKLIST: CONTROL III ♂

Loading Habrobracon into Modules

Torque: 24 ± 2 in. ~~lbs~~ oz.

Date: [illegible]

Programmed time: Start T - 700 Actual time: Start 0351
Finish T - 640 Finish

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

Person Loading

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	GRHS

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	

Biosatellite Flight B

CHECKLIST: CONTROL I ♀

Loading Habrobracon into Modules

Torque : 24 ± 2% in. 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~~5~~ 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 oz. in. ~~lbs.~~

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. ~~lbs.~~

Date: 7 Sept 66

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. 13F1          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 38  .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 02   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  .045 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  2230 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                                                                +5 VDC REG CAP  50  4.88 VDC
                                       ENVIRON. CONTROL SUBSYSTEM                 A115  115 VAC REG CAP  33  110. VAC
    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                        00000000000000000
    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              CAP Z1  TEMP      29  47.3 DEF                O W S P ERROR        0
                                   A89 CAP Z2  TEMP      31  79.0 DEF                VER ARM COMMAND      0
                                   A90 AFT COV TEMP RV   31  60.3 DEF
    N2 REG  PRESS   35  38.2 PSG                                                      PROGRAM TIMER        19 25
                                                                                      TIMER CH 1       27
    COARSE MAG A    00 -600. MLG                                                      TIMER CH 2       42
    COARSE MAG B    00 -600. MLG          RECOVERY SUBSYSTEM                          TIMER CH 3       32
                                                                                      TIMER CH 4       18
                                       BAROSW  MONITOR   38  1
                                       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	Biol. 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]	-5 VDC		4.88		

Fig. 13.

NASA-AMES RESEARCH CENTER

BIOSATELLITE ORBITAL TEMPERATURES

ORBITS 13F

TIME 2251 17 29 19

FLIGHT + 4 HRS

TIME 21 29

EXPERIMENT	DOSE	A NO.	FLIGHT	NO. 1 CONTROL FLIGHT SIMULATION (17 27)	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-1038 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 MEROMIXON	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-1135 LYSOGENIC BACTERIA	NONE	186	65	–		65	
	500	187	67	69			
	2500	188	67	69			
	1000	189	67	69			
P-1139 ADULT DROSOPHILA	NONE	190	65	70	71	66	
	2000	191	67	69	↓		
P-1140 LARVA DROSOPHILA	NONE	192	65	70	71	66	
	1300	193	67	69	↓	67	
				R.H. 54%	64%		

FLIGHT CAPSULE AVERAGE TEMP.

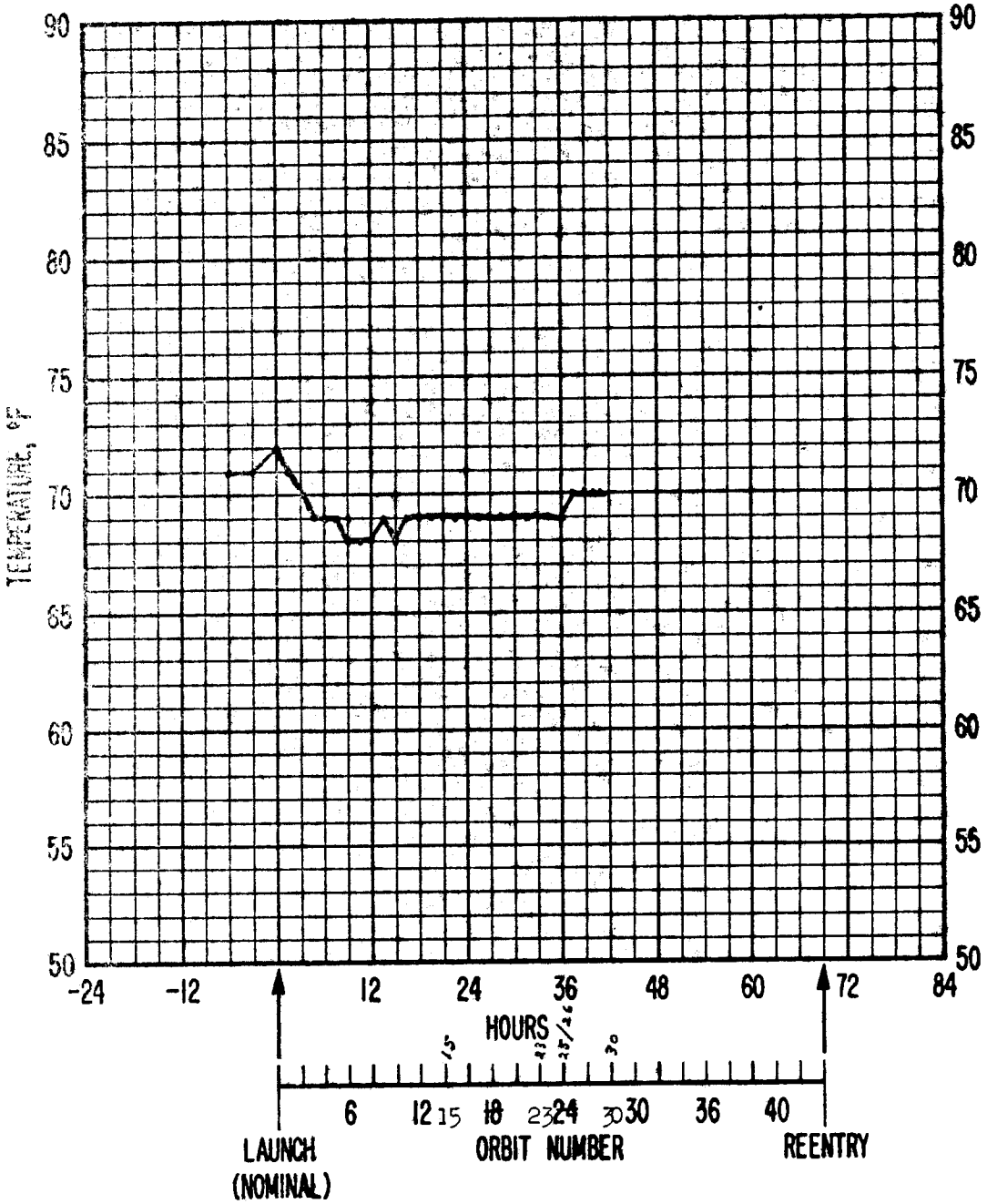
FWD	68
AFT	67
LYSO	

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

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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	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)

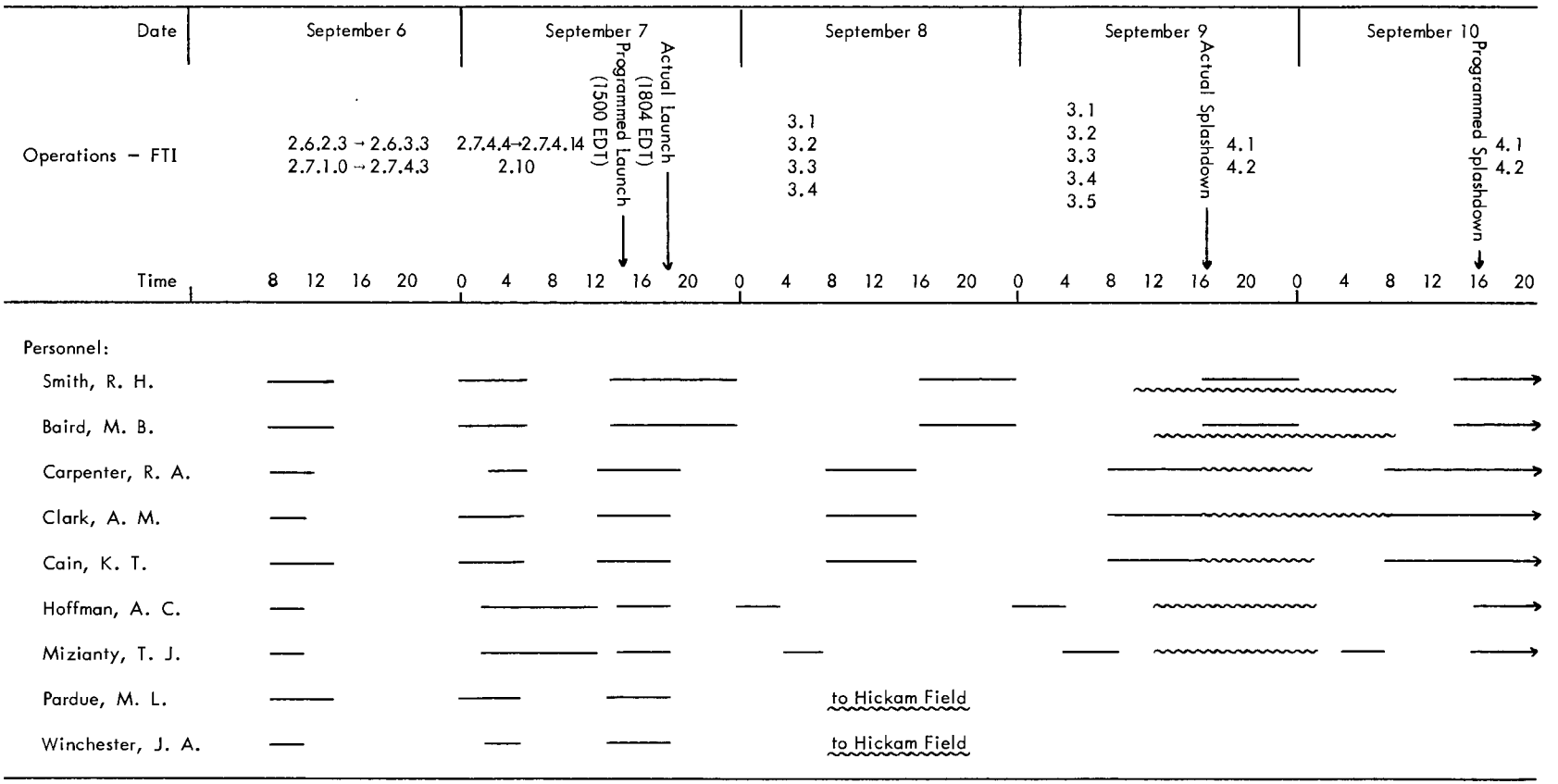
5.4.3.4.0 Unloading of radiation exposure detectors

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 because 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

SECTION 4

BIOLOGY DIVISION

HABROBRACON EXPERIMENT P-1079

QUARTERLY PROGRESS REPORT

TO THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

OCTOBER 1 — DECEMBER 31, 1967

(Printed separately as ORNL-TM-2312)

ORNL-TM-2312

BIOLOGY DIVISION

QUARTERLY PROGRESS REPORT
TO THE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

October 1 - December 31, 1967

NOVEMBER 1968

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

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:

October 1 - December 31, 1967

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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:

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I. INTRODUCTION

R. C. von Borstel Roger H. Smith

The preliminary analysis of the Habrobracon portion of the Biosatellite II experiment is presented in this report. It is a preprint of the article that subsequently appeared in BioScience (von Borstel, Smith, Grosch, Whiting, et al., 1968).

Besides this, a final analysis has been made of the fertilizing capacity of sperm from males that had been in the Biosatellite. Presented is evidence that the effect found (enhanced fertilizing capacity) is a true effect of weightlessness in combination with radiation and is not attributable to some other condition of space flight.

The computer program has been modified and brought up to date. The program as now used is included.

A summary of the data used for estimating the mutation parameter of dominant lethality in Habrobracon sperm is also included. An analysis of these data will appear in a later report, after the dosimetry has been completed.

Literature Cited

von Borstel, R. C., R. H. Smith, D. S. Grosch, A. R. Whiting, R. L. Amy, M. B. Baird, P. D. Buchanan, K. T. Cain, R. A. Carpenter, A. M. Clark, A. C. Hoffman, M. S. Jones, S. Kondo, M. J. Lane, T. J. Mizianty, M. L. Pardue, J. W. Reel, D. B. Smith, J. A. Steen, J. T. Tindall, and L. R. Valcovic, 1968, Mutational response of Habrobracon in the Biosatellite II experiment, BioScience 18: 598-601.

II. MUTATIONAL RESPONSE OF HABROBRACON IN THE BIOSATELLITE II EXPERIMENT

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D. S. Grosch
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The Biosatellite Habrobracon experiment was designed to survey mature sperm and all different stages of oogenesis for mutational effects, particularly dominant lethality, recessive lethal and visible mutation frequencies, and inherited partial sterility. These were scored at all stages of the life cycle and all are total genome effects. Additional data were collected and are being accumulated on survival, life span, and biochemical and behavioral differences of the animals themselves.

Since each Habrobracon requires careful attention, the experiment was planned so that many Habrobracon investigators from several different institutions would work in concert for a limited time before, during, and after the flight. In this way the information could be obtained at lowest cost from the unique experience.

Experimental Design and Methods

Two hundred seventy-eight males of the lemon mutant strain and 280 females heterozygous for lemon, honey, and cantaloup markers were placed in five polypropylene packages designed for them. Three ground-based controls included: an exact mock-up of the spacecraft with a radiation source (Control I), a ground-based control incubator set at a constant temperature (Control II), and a ground based control incubator designed to follow by 1 hr the temperature profile of the spacecraft (Control III).

The five packages in the spacecraft and in the ground-based controls were placed relative to the 85-strontium source so that the Habrobracon would receive γ-radiation exposures of 4000 R, 2000 R, 1000 R, 500 R, and 0 R. These exposures were not approximated for several reasons: the flight duration was shortened; the 1000 R nominal-exposure package was tilted in the spacecraft; dose-square relations were not accurately observed when the spacecraft was designed; and there was an undetermined amount of low energy scattered radiation. Geometric corrections have not yet been established. Thus, the true values for the exposures received by the Habrobracon are not now known to within 15%. Packages in the spacecraft received exposures of ~2400 R, ~1200 R, ~600 R and ~530 R, ~350 R, and ~0.5 R. Packages in the ground-based control setup received ~2400 R, ~1200 R, ~700 R, ~360 R, and ~1.5 R. The bracket holding the 1000 R nominal-exposure package in the spacecraft had been turned, inadvertently, 180° during spacecraft assembly so that the package was tilted facing upward at an angle of approximately 30° away from the source. This error was not noted or corrected during assembly of the spacecraft. It was detected post-flight when the Toshiba glass rod dosimeters and LiF powder were being measured. The error was verified by examination of photographs taken during the disassembly of the spacecraft.

Two radiation experiments were performed. Some Habrobracon were irradiated prior to launch, some of them were irradiated during the flight, and some were not irradiated at all. The Habrobracon irradiated before launch were given 2000 R at a rate of exposure of 120.4 R/min. The rates of exposure for those irradiated during the flight were much lower.

Analysis of the males followed established procedures of von Borstel and Rekemeyer (1959) for dominant lethality, recessive lethality, and inherited partial sterility. Analysis of the females followed the procedures of Whiting, Smith, and von Borstel (1968) for total dominant and recessive lethality induced during oogenesis, and of Grosch (1968) for oogonial killing and dominant lethality.

A disassembled package for Habrobracon is shown in Fig. 1. The same package, in different degrees of assembly, is shown in Figs. 2 and 3. Three of the packages are like the one shown in the figures. The 4000 R nominal-exposure package has a concave face for placement of the modules containing the Habrobracon to ensure adherence to the isodose requirements. The 0 R nominal-exposure package holds multi-layered modules so that more Habrobracon could be contained. Some of the Habrobracon in this package were irradiated before the launch.

AR-1632B-P1079-3

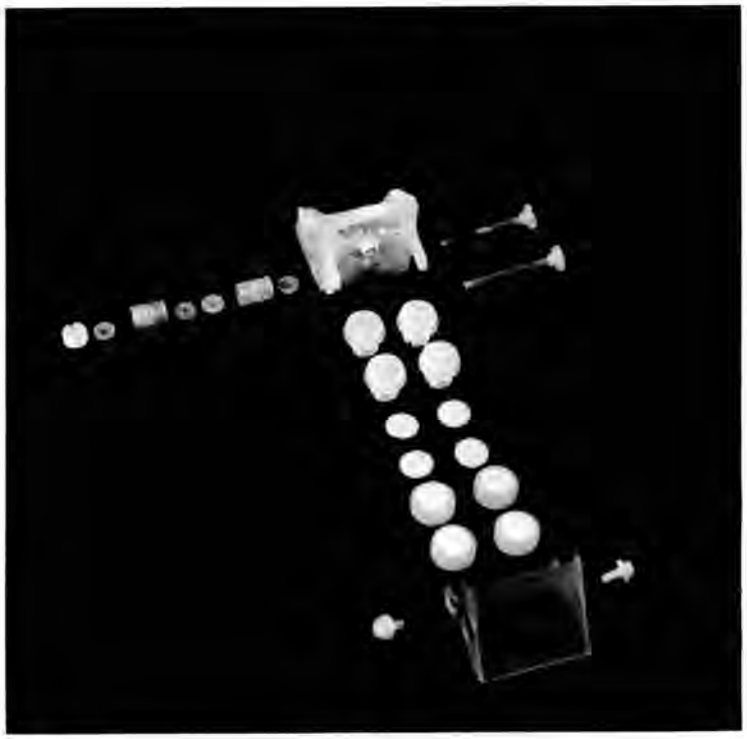

Fig. 1. A Disassembled Flight Package Used for the Habrobracon Portion of the Biosatellite II Experiment.

AR-1632B-P1079-4

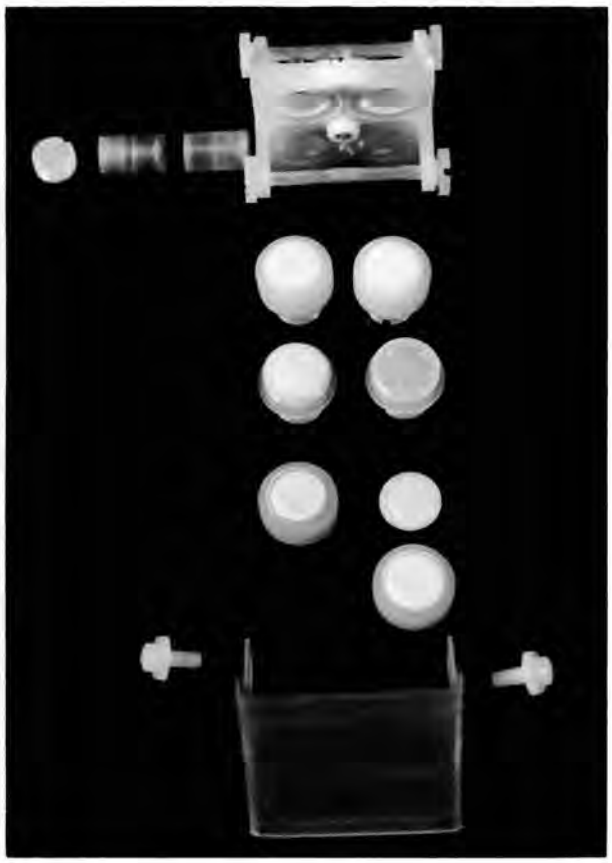

Fig. 2. A Partially Assembled Flight Package.

The tubes for lithium fluoride powder are in place on the bracket, two of the modules are capped, one of the modules has a screen overlying the depression where the Habrobracon are held, and the other module is still disassembled.

AR-1632B-P1079-5

Fig. 3. A Partially Assembled Flight Package.

The modules and tubes for lithium fluoride powder are in place. The secondary electron equilibrium shield lies in front of the rest of the package.

The Habrobracon were held in four modules which, in turn, were screwed on the part of the package facing the radiation source. These are identified by their position facing the source; i.e., LR is lower right, UL is upper left, etc. Each module also carries three Toshiba glass rod dosimeters. Additional dosimetry was accomplished by placing LiF powder in tubes held in front and behind the modules. A thermistor to record the local temperature is located centrally between the modules.

Results

Numerical data are still being accumulated; in this report, only qualitative results are presented. Every animal survived the experience of the flight. Males that had been in orbit were disoriented in their mating behavior for 2 days after their flight. In contrast, the females from the spacecraft were not disoriented in their complex egg-laying and feeding reactions.

Sperm. The exposure-hatchability curve of fertilized eggs following irradiation of sperm in the flight vehicle and in ground-based controls is shown in Fig. 4. It can be seen that there is no significant difference between the flight and ground-based control animals. The differences among the modules are small, verifying the essential similarity of replicate modules at each exposure. Flight conditions neither enhance nor antagonize the effect of radiation on sperm dominant lethality. The spontaneous recessive embryo lethal mutation frequencies in sperm were also the same in the spacecraft and the ground-based control setup. The recessive lethal mutation frequencies and frequencies of inherited partial sterility induced in sperm by the radiation are still under analysis.

Metaphase I oocytes. Exposure-hatchability curves of eggs irradiated during the first meiotic metaphase are shown in Fig. 5. Since the females were virgins, dead embryos are due to either dominant or recessive lethal mutations or both. There is a marked difference in radiation sensitivity between eggs irradiated in the spacecraft and those on the ground. In the orbiting samples, there were differences from module

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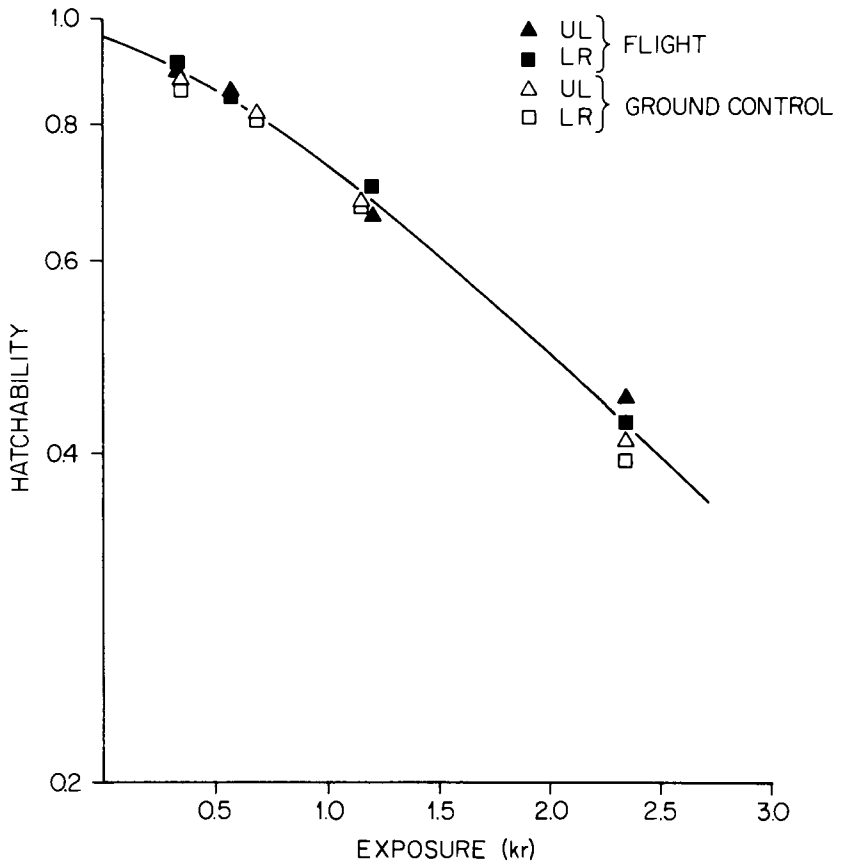

Fig. 4. The Hatchability of Fertilized Eggs from Females Mated to Males Irradiated in the Spacecraft and the Ground-Based Control Setup

UL = Habrobracon from upper left modules; LR = Habrobracon from lower right modules.

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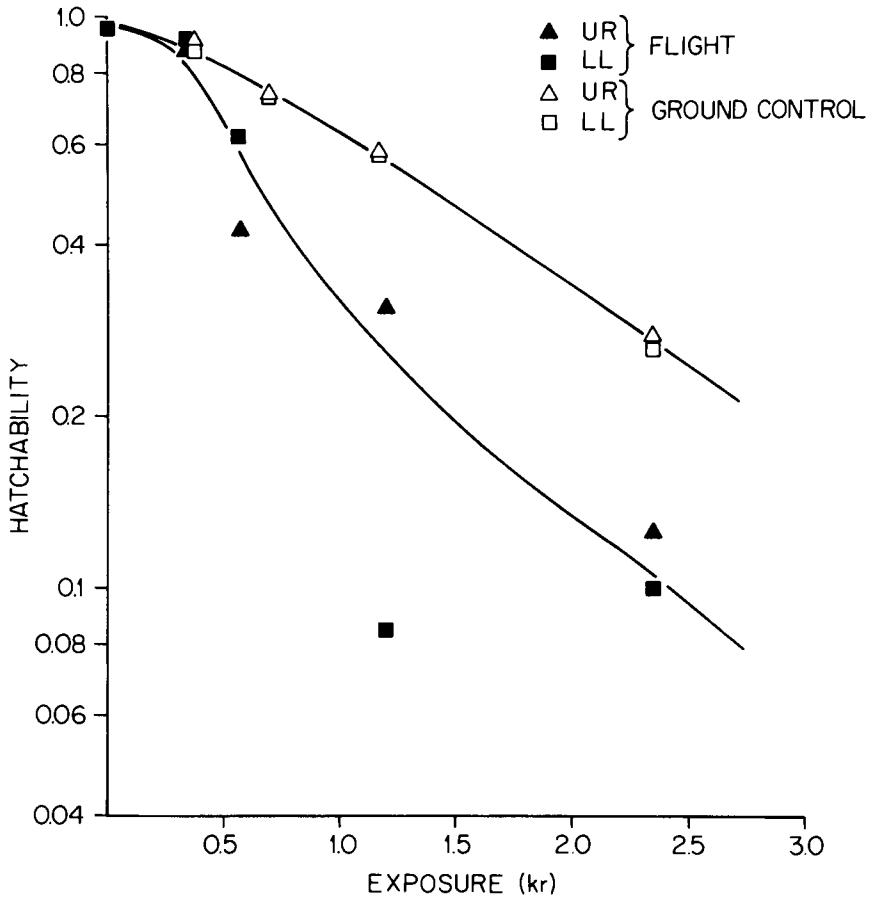

Fig. 5. The Hatchability of Unfertilized Eggs from Virgin Females Irradiated in the Spacecraft and the Ground-Based Control Setup.

The eggs represent the class that was in the first meiotic metaphase at the time of irradiation. UR = Habrobracon from upper right modules; LL = Habrobracon from lower left modules.

to module. It appears that flight conditions enhance the effect of γ-radiation in producing lethality in metaphase I oocytes.

With those metaphase I oocytes irradiated with an acute exposure of 2000 R prior to the time of flight, a similar difference was found between eggs flown in the spacecraft and eggs held in the ground-based controls. The eggs from these females, however, had higher hatchabilities than any of those irradiated during the flight. Recovery from the radiation damage to these eggs (and to those under irradiation) must have been occurring during the flight.

Prophase I oocytes. The eggs laid on the second day after the flight had terminated are from a homogeneous class of large, nearly mature oocytes that were in the diplotene state of meiosis during the flight. At the radiation exposures used, hatchability was above 90%. Genetic recombination in chromosome I is not affected by low doses of radiation during prophase I. We anticipated no difference, and none was observed as a result of space flight.

The eggs laid on the third day after the flight had terminated were small oocytes during the flight.* They were no larger than the nurse cell mass with which they were in contact. Yolk synthesis, transport, and deposition are in progress in oocytes of this size. These oocytes responded like the metaphase I oocytes in that there was a large sensitivity difference between those irradiated in the spacecraft and those on the ground, those in the spacecraft being more sensitive.

Transitional and primitive oogonia.* Reproductive performance of the females was the principal criterion for effects on these stages. The pattern of egg production for the Habrobracon females recovered from the spacecraft differed drastically from results obtained with females in the ground-based controls. Normally, after the first 3 days, a group of irradiated females will begin to produce fewer eggs than an unirradiated group. The irradiated group will go through a low period from 5 (acute irradiation) to 8 or 9 (protracted irradiation) days after being treated. The egg production then goes up, but never to the level of the control.

*Principal responsibility of the group from North Carolina State University.

The ground-based control females behaved as expected, but those from the spacecraft showed a compensatory pattern of egg production. Although egg production was slightly lower for irradiated flight females than the ground and flight unirradiated controls (0 R) for the first week, the egg production was higher than the 0 R controls for the remaining portion of the 20-day study.

The data for females irradiated in the nominal 4000 R position (receiving approximately 2400 R in this flight) are shown graphically in Fig. 6. There is an antagonistic effect of space flight with radiation in oogonia. The radiation response of these mitotically reproducing cells is effectively eliminated by the flight.

Life span.* Although a comparison of individual dose levels shows no impressive statistical differences, a significantly longer life span of females from the satellite can be shown in pooled data when compared to those of the ground control.

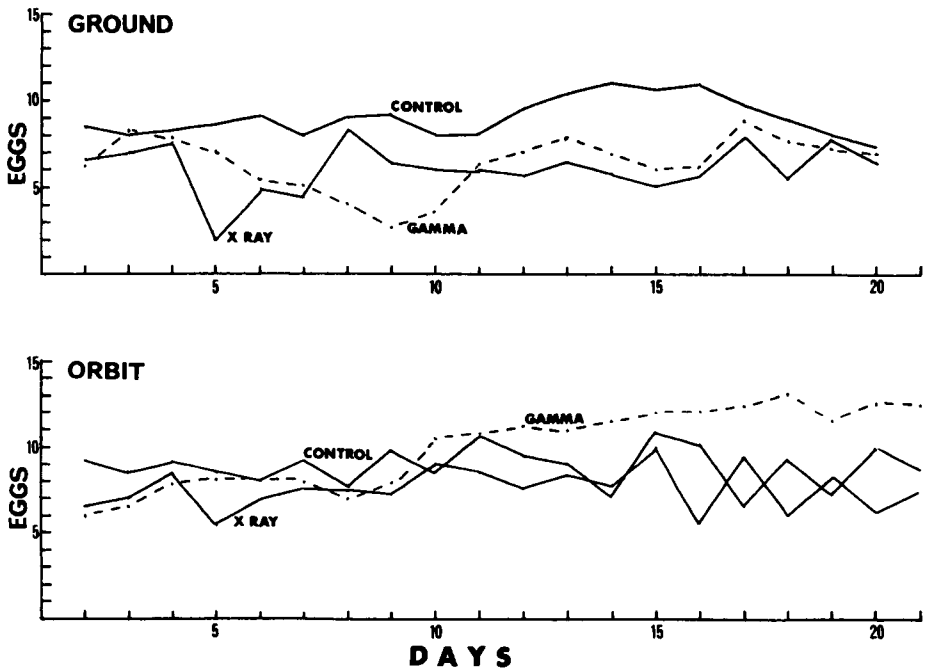

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Fig. 6. Mean Daily Egg Production for Samples of Habrobracon Virgin Females from the Spacecraft and the Ground-Based Control Setup.

In each case, the curves have been drawn for unirradiated controls, for females receiving an acute pre-flight exposure of 2000 R of X-radiation, and for females receiving ~2400 R of γ-radiation during the flight itself.

Discussion

Null, enhancing, and antagonistic effects of the space flight with radiation were found in the Habrobracon experiment.

Our results to date indicate no effect of space flight on radiation damage to mature sperm. Sperm are static, fully differentiated cells in which radiation-repair systems are slightly, if at all, operative, even under normal conditions. Space flight seemed to enhance the effect of radiation on meiotic cells which are static but in which repair systems are operative; space flight appeared to antagonize the effect of radiation on mitotic cells and on cells transitional between mitosis and meiosis in which repair systems are also operative.

The differentiation of oogonia into meiotic oocytes is a complex process. These cells, which form a sequential series, are metabolically active but are in different metabolic states. The patterns of response of these cells, in terms of fecundity and fertility, differ for radiation and for a variety of chemical agents (Grosch, 1963). It should not be entirely unexpected to find that meiotic and mitotic cells respond in different ways to space-flight factors.

Even though the effects of space flight are probably complex, one can speculate about the possible targets within these different cell types.

First, the radiation-repair systems may be different in meiotic and mitotic cells. In the meiotic cells the repair system is inhibited by space-flight factors; in mitotic cells the repair system is "stimulated" or unmasked to a greater extent. Perhaps in space the mitotic cells respond by being slowed in the cell cycle so that repair can be effected over a longer period of time.

Second, broken ends of chromosomes undergoing meiosis may move further apart so that they have difficulty in rejoining, whereas broken chromosome ends in the transitional cells or in interphase oogonia are packed more closely together and can rejoin more readily. This hypothesis can be stated as an expansion or contraction of the chromosome-rejoining sites in different cell types by space-flight factors.

A third possibility is that cells may metabolize faster in the ground-based controls than in the flight vehicle. A case could be made to explain the enhancing and antagonizing effects by resorption of the eggs and their replacement by differentiation of gonial cells. The sperm would, of course, remain equally viable under both conditions. Lower temperature in the flight vehicle would not be a plausible reason for a lower metabolic rate since hourly measurements of temperature in the spacecraft and the ground-based controls gave almost identical readings.

These hypotheses are not necessarily mutually exclusive, nor are they the only possibilities that come to mind. They are reasonable and consistent with our findings to date.

It is plausible that neither weightlessness nor vibration (or other flight factors) alone could cause the biological effects noted. A case can be made that the interactions of weightlessness together with one or more of the other factors is essential. For example, vibration could dislocate components of a cell, and a gravity-free state could keep the components from settling back to an earth-bound position within the cell.

Summary

When dominant lethality in Habrobracon sperm was the criterion, no interaction effects of γ-radiation and space flight were found. When dominant and recessive lethality in Habrobracon oocytes in the first meiotic metaphase was the criterion, a marked enhancing effect of radiation in space flight was found. The late prophase I oocytes were insensitive, but the small prophase I oocytes were similar to metaphase I oocytes in exhibiting an enhancing effect of radiation during space flight. When killing of transitional and primitive oogonia was measured by fecundity, a marked antagonistic effect of radiation by space flight was found. The enhancing and antagonistic effects were observed whether the Habrobracon were irradiated either before or during the flight, although the effect was greater in those Habrobracon irradiated during the flight.

Acknowledgments

We want to acknowledge the willing support and unstinting helpfulness of everyone associated with this experiment from our own laboratories and universities directly involved with the Habrobracon experiment as well as General Electric Corporation, Union Carbide Corporation, Ames Research Center, Cape Kennedy Operations, the United States Air Force at Hickam Field, the University of Hawaii, the University of California, the Atomic Energy Commission, and the National Aeronautics and Space Administration. This gives but small indication of the extraordinary amount of planning and programming needed to make the experiment possible.

Literature Cited

Grosch, Daniel S., 1963, Cytological interpretations of five types of induced modifications in the oviposition patterns of the wasp, Habrobracon, Proc. XIth Intern. Congr. Genetics 1: 73.

Grosch, Daniel S., 1968, The reproductive performance of female braconids after (A) brief and (B) protracted exposures to ionizing radiation, in Symposium on the Use of Isotopes and Radiation in Entomology, International Atomic Energy Agency, Vienna (in press).

von Borstel, R. C., and M. L. Rekemeyer, 1959, Radiation-induced and genetically contrived dominant lethality in Habrobracon and Drosophila, Genetics 44: 1053-1074.

Whiting, A. R., Roger H. Smith, and R. C. von Borstel, 1968, Methods for radiation studies during oogenesis in Habrobracon juglandis (Ashmead), in Symposium on Effects of Radiation in Meiotic Systems, International Atomic Energy Agency, Vienna, pp. 201-208.

III. FERTILIZING CAPACITY OF SPERM FROM MALES IN THE BIOSATELLITE II EXPERIMENT

Roger H. Smith Diana B. Smith

After the Biosatellite II was recovered, it was found that Habrobracon males from the flight had an abnormal mating behavior (Valcovic et al., 1968). This was the first observed difference between the animals in the spacecraft and in the ground-based control setup. An obvious follow-up was to compare the frequencies of fertilized eggs from these matings.

Results

The computer prints out the proportion of nonfertilized eggs and their confidence limits (von Borstel et al., 1968). We have revised these data to show the proportion of fertilized eggs from the sperm of males in the spacecraft and in the ground-based control setup (Table 1).

Except for males that received low doses or were irradiated before the launch, it can be seen that the males carried in the spacecraft consistently had a higher fertilizing capacity. An exposure-action curve is shown in Fig. 7 which compares the estimated proportion of diploid eggs at each exposure. The proportion of surviving females from all adults is shown in Fig. 8.

Discussion

Figure 8 shows best the constant superiority of the fertilizing capacity of the males which had been in the spacecraft. Since the effect is related only to higher exposures received in orbit, the increased fertilizing capacity of the sperm appears to be an enhancing effect of radiation combined with weightlessness.

Summary

Although males carried in the spacecraft showed a general inability to mate, their sperm had an increased fertilizing capacity, but only after receiving radiation in flight.

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.

von Borstel, R. C., Roger H. Smith, Anna R. Whiting, Katherine T. Cain, Joan W. Reel, Martha S. Jones, Margaret J. Lane, Judith A. Steen, Julie T. Tindall, and Diana B. Smith, 1968, Dominant lethality in Habrobracon sperm in the Biosatellite II experiment, ORNL-TM- 2312, Quarterly Progress Report to NASA covering the period October 1-December 31, 1967, pp. 23-25 (Section V, this report).

Table 1. Frequency of eggs fertilized by males from the spacecraft and the ground-based control setup

Nominal Exposure (R)	Estimated Exposure (R)	Package	Diploid Eggs (%)	Female Adults (%)
4000	2540	FLT	59.94	42.15
	2550	GC1	57.72	37.95
2000	1272	FLT	66.04	57.40
	1246	GC1	56.29	48.01
1000	590	FLT	68.50	64.39
	724	GC1	58.41	54.91
500	356	FLT	64.79	60.22
	371	GC1	62.10	59.35
0	0.7	FLT	65.82	63.77
	1.7	GC1	62.51	62.82
pre-2000	2000	FLT	58.66	45.87
		GC1	61.51	46.43
pre-2000	2000	GC3	65.75	47.81
		pretest	53.04	39.75

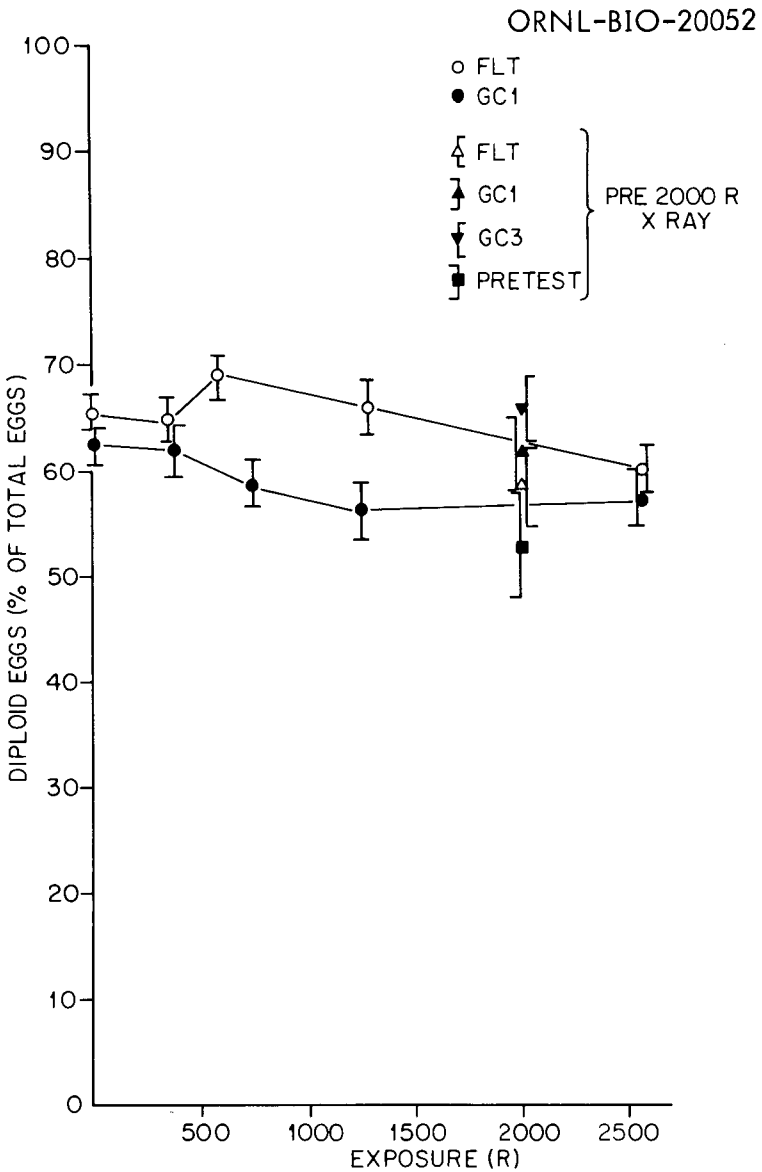

Fig. 7. The Dose-Fertilization Frequencies of Habrobracon Males in the Biosatellite II Experiment

The frequency of fertilization is shown as an estimate of the proportion of diploid (fertilized) eggs.

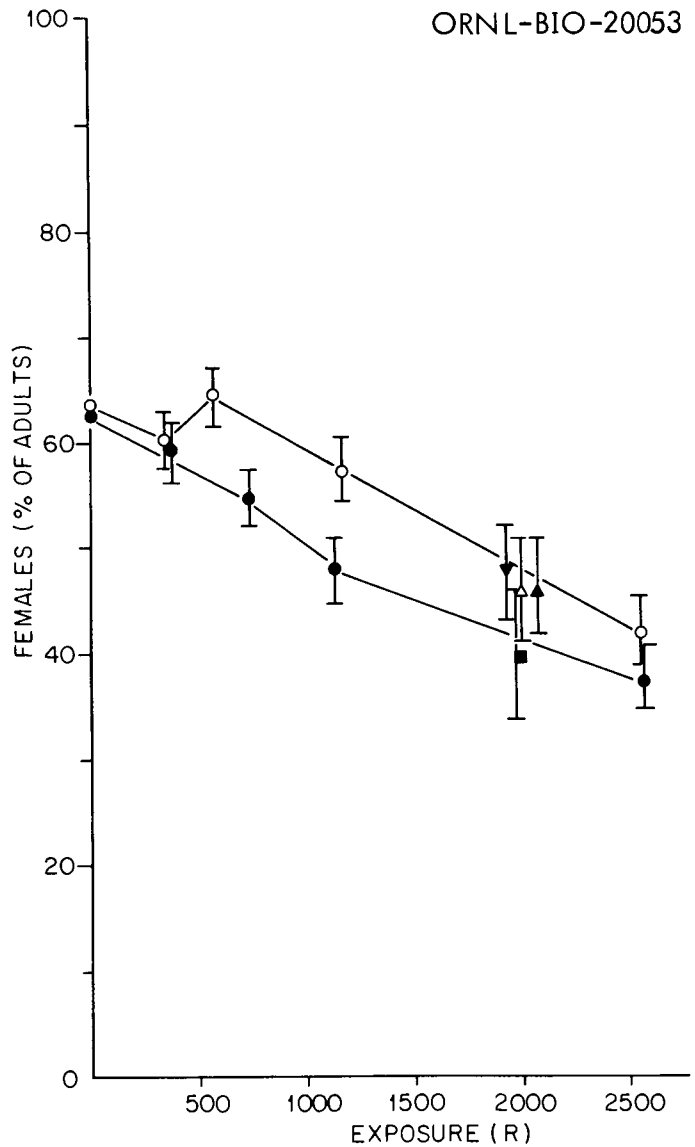

Fig. 8. The Dose-Fertilization Frequencies of Habrobracon Males in the Biosatellite II Experiment

The frequency of fertilization is expressed as the proportion of female offspring among all adult offspring.

IV. COMPUTER PROGRAM AND SUBROUTINES FOR ANALYSIS OF HABROBRACON DATA

Diana B. Smith Roger H. Smith

A program was devised to handle the large amounts of data accumulated in the Biosatellite Project (Smith and Smith, 1967). This has been revised to include computation of confidence limits. Also, the sex ratios of the eggs (primary sex ratio) are computed, and the adults (secondary sex ratio) are presented.

The program is shown in sequence on the following pages (pp. 17-22).

Literature Cited

Smith, D. B., and R. H. Smith, 1967, Computer tabulation and analysis of data, ORNL-TM-1732, Quarterly Progress Report to NASA covering the period July 1-September 30, 1966, pp. 9-15.

```
**FTN,L,P,E.
C     PROGRAM DOMINANT LETHALITY
      IMPLICIT REAL*8(A-H,O-Z)
      DATA ILIST/4H  E ,4H  H ,4H  1 ,4H  2 ,4H 3A ,4H 3B ,4H 4A ,4H 4B
     *,4H  5 ,4H  N ,4H  E ,4H  M ,4H  L ,4H SL ,4H  P ,4H  E ,4H  M ,
     * 4H  L ,4H    ,4H    /
      DATA ICCN/4H  D /
      DIMENSION VIRG(22),WENCH(22),S(22),F(22),X(22)
      DIMENSICN ILIST(20),LIST(20)
      DIMENSION IX(2),ID(2)
  100 FCRMAT(2I3,22F2.0)
  200 FORMAT(1H0,I3,1X,I3,22F5.0,I5)
  300 FORMAT(1H0,120X,5HERROR)
  400 FCRMAT(1H1,15HUNMATED FEMALES,F7.0///)
  500 FORMAT(1H0,5X,A4,5X,F8.0,5X,F8.6)
  600 FORMAT(1H0,7H  8   F,20A5,13X,1HT)
  700 FORMAT(1H1,15H  MATED FEMALES,F7.0///)
  800 FORMAT(1H1,18HDOMINANT LETHALITY,20X,F8.0,16H UNMATED FEMALES,10X,
     * F8.0,14H MATED FEMALES///)
  808 FORMAT(7A4,A3,A4,A3,A1,A2,A1,6A4,3A2)
 1000 FCRMAT(1H0,5X,A4,5X,F9.6)
   99 FCRMAT(1H1,'DATE',T15,'EXPERIMENT',T40,'EXPOSURE')
  999 FORMAT('0',2A4,T15,4A4,T40,A4,A3,//)
   88 FCRMAT(1H0,'FEMALE NOS',T15,'SEX')
  888 FCRMAT('0',A4,A3,T15,A1,T20,A2,T27,A1,//)
   77 FORMAT(1H0,'STOCKS',T10,'TREATED',T20,'MATED TO')
  777 FORMAT(1H0,T10,2A4,T20,2A4,T30,2A4,//)
      REWIND 10
      REWIND 11
 3000 READ(50,808,END=4000) LIST
      PRINT 99
      PRINT 999,(LIST(I),I=1,8)
      PRINT 88
      PRINT 888,(LIST(I),I=9,11)
      PRINT 77
      PRINT 777,(LIST(I),I=14,19)
      PRINT 600,ILIST
      DO 1 I=1,22
      VIRG(I)=0.
    1 WENCH(I)=0.
      CNT1=0.
      CNT2=0.
      READ(50,100,END=4000) IX,(S(I),I=1,22)
    2 ID(1)=IX(1)
      ID(2)=IX(2)
      NT=0
      DO 3 I=1,22
    3 F(I)=0.
      IND=0.
    4 DO 5 I=1,22
    5 F(I)=F(I)+S(I)
      SCOL=0.
      DO 6 I=3,22
    6 SCOL=SCCL+S(I)
      IF(SCOL.EQ.S(1))GO TO 8
      IND=1
    8 SEMB=0.
      NT=NT+1
      DO 9 I=3,9
    9 SEMB=SEMB+S(I)
      IF(SEMB.EQ.S(1)-S(2)) GO TO 11
```

```
      IND=1
   11 READ(50,100,END=2000)IX,(S(I),I=1,22)
      IF(IX(1).NE.ID(1))GO TO 111
      IF(IX(2).EQ.ID(2))GO TO 4
  111 CONTINUE
      FEM=F(20)
      IF(FEM.NE.0.) GO TO 15
      IF(F(2)/F(1).LT..80) GO TO 15
      DO 14 I=1,22
   14 VIRG(I)=VIRG(I)+F(I)
      CNT1=CNT1+1.
      GO TO 17
   15 DO 16 I=1,22
   16 WENCH(I)=WENCH(I)+F(I)
      CNT2=CNT2+1.
   17 PRINT 200,ID,(F(I),I=1,22),NT
      IF(IND.EQ.0.) GO TO 19
      PRINT 300
   19 IF(IX(1)+IX(2).NE.0) GO TO 2
      DIV1=VIRG(1)
      DIV2=WENCH(1)
      IF(DIV1.EQ.0.) DIV1=1.
      IF(DIV2.EQ.0.) DIV2=1.
      DO 21 I=1,22
      S(I)=VIRG(I)/DIV1
   21 F(I)=WENCH(I)/DIV2
      PRINT 400,CNT1
      PRINT 999,(LIST(I),I=1,8)
      PRINT 500,(ILIST(I),VIRG(I),S(I),I=1,20)
      CALL CICONF(VIRG(2),VIRG(1),XL,XU)
      PRINT 5004,XL,XU
      PRINT 700,CNT2
      PRINT 999,(LIST(I),I=1,8)
      PRINT 500,(ILIST(I),WENCH(I),F(I),I=1,20)
      CALL CICONF(WENCH(2),WENCH(1),XL,XU)
      PRINT 5004,XL,XU
 5004 FORMAT('0','BINOMIAL CONF. LIMITS HATCH.'2F10.6)
      WRITE(10)CNT1,(VIRG(I),I=1,22)
      WRITE(11)CNT2,(WENCH(I),I=1,22),LIST
      GO TO 3000
 4000 END FILE 10
      END FILE 11
      REWIND 10
      REWIND 11
      DO 24 I=1,22
   24 VIRG(I)=0.
      CNT1=0.
   26 READ(10,END=5000) C,(S(I),I=1,22)
      DO 25 I=1,22
   25 VIRG(I)=VIRG(I)+S(I)
      CNT1=CNT1+C
      GO TO 26
 5000 DO 27 I=1,22
   27 S(I)=VIRG(I)/VIRG(1)
      PRINT 5001,CNT1
      PRINT 999,(LIST(I),I=1,8)
 5001 FORMAT('1',F5.0,' TOTAL UNMATED FEMALES')
      PRINT 500,(ILIST(I),VIRG(I),S(I),I=1,20)
      CALL CICONF(VIRG(2),VIRG(1),XL,XU)
      PRINT 5004,XL,XU
   28 READ(11,END=2000) CNT2,(WENCH(I),I=1,22),LIST
      IF(CNT2.EQ.0.) GO TO 28
```

```
      DC 29 I=1,22
   29 F(I)=WENCH(I)/WENCH(1)
      P=F(19)
      VU=S(19)
      FC=1.-P/VU
      CCN=1.-FC
      DC 22 I=2,22
   22 X(I)=(F(I)-S(I)*CCN)/FC
      DCM=1.-X(2)
      PRINT 800,CNT1,CNT2
      PRINT 999,(LIST(I),I=1,8)
      PRINT 1000,ICON,DOM
      PRINT 1000,(ILIST(I),X(I),I=2,20)
      PC=(WENCH(19)*VIRG(1))/(WENCH(1)*VIRG(19))*100.
      PRINT 5002,PC
 5002 FORMAT('0',' PER CENT HAPLOID EGGS    'F10.5)
      PX=(WENCH(19))/(WENCH(19)+WENCH(20))*100.
      PRINT 5003,PX
 5003 FORMAT('0',  ' PER CENT MALES IN ADULTS',F10.5)
      A=INT((100.-PC)/100.*WENCH(1)+.5)
      B=INT(DOM*A+.5)
      CALL CICONF(B,A,XL,XU)
      PRINT 5005,XL,XU
 5005 FORMAT('0 CONFIDENCE LIMITS DOM. LETHALITY',2F10.6)
      B=INT(X(2)*A+.5)
      CALL CICONF(B,A,XL,XU)
      PRINT 5006,XL,XU
 5006 FORMAT('0 CONFIDENCE LIMITS DIPLOID HATCHABILITY',2F10.6)
      A=WENCH(1)
      B=INT(A*PC/100.+.5)
      CALL CICONF(B,A,XL,XU)
      PRINT 5007,XL,XU
 5007 FORMAT('0 CONFIDENCE LIMITS HAPLOID EGGS='2F10.5)
      A=WENCH(19)+WENCH(20)
      B=WENCH(19)
      CALL CICONF(B,A,XL,XU)
      PRINT 5008,XL,XU
 5008 FORMAT('0 CONFIDENCE LIMITS MALES IN ADULTS'2F10.5)
C*****CONFIDENCE LIMITS ON HAPLOIC EGGS,DOMINANT LETHALITY,AND DIPLOID****
C*****HATCHABILITY ASSUME VIABILITY ESTIMATE OF MALES IS CERY GOOD     ****
C*****AND SAMPLE SIZES LARGE                                            ****
      GC TO 28
 2)00 CALL EXIT
      STOP
      END
```

```
      SUBROUTINE CICONF(A,B,XL,XU)
      IF(B.GT.300) GO TO 1
      CALL BICONF(A,B,XL,XU)
      RETURN
    1 P=A/B
      IF(P.LT..10) GO TO 2
      IF(P.GT..90) GO TO 22
      XL=1.96*SQRT(P*(1.-P)/B)
      XU=P+XL
      XL=P-XL
      RETURN
    2 CALL POIS (A,P,XL,XU)
      RETURN
   22 C=B-A
      X=C/B
      CALL POIS (C,X,XX,XZ)
      XL=1.-XZ
      XU=1.-XX
      RETURN
      END
```

```
      SUBROUTINE BICONF(TN,TM,P1,P2)
C*****COMPUTES BINOMIAL CONFIDENCE LIMITS  XN=OBSERVED NUMBER OUT OF TM
C*****  P1=LOWER LIMIT, P2= UPPER LIMIT  95 PER CENT
      DATA E/.0001/
      IF(TM.EQ.0.) GO TO 430
      Q=TM+1.
      P1=TN/TM
      P5=P1
      IF(P1.LT.1.) GO TO 50
      P1=.99
   50 IF(TN.EQ.0.) GO TO 260
      P3=0.
      CT=1.
   90 X=TM*ALOG(1.-P1)
      Z=ALOG(P1)-ALOG(1.-P1)
      S=EXP(X)
      Y=1.
  110 IF(Y.GE.TN)    GO TO 170
      X=  X+Z+ALOG(Q-Y)-ALOG(Y)
      S=S+EXP(X)
      Y=Y+1.
      GO TO 110
  170 IF(ABS(S-.975).LT.E) GO TO 260
      IF(CT.GT.20.) GO TO 260
      IF(S-.975.LT.0.) GO TO 240
      P3=P1
      P1=(P3+P5)/2.
      CT=CT+1.
      GO TO 90
  240 P5=P1
      P1=(P3+P5)/2.
      CT=CT+1.
      GO TO 90
  260 P2=TN/TM
      P5=P2
      IF(P2.GT.0.) GO TO 280
      P2=.01
  280 IF(TN.EQ.TM) GO TO 440
      P3=1.
      CT=1.
  290 X=TM*ALOG(P2)
      S=EXP(X)
      Z=ALOG(1.-P2)-ALOG(P2)
      Y=1.
  310 IF(Y.GE.TM-TN) GO TO 365
      X=  X+Z+ALOG(Q-Y)-ALOG(Y)
      S=S+EXP(X)
      Y=Y+1.
      GO TO 310
  365 IF(ABS(S-.975).LT.E) GO TO 440
      IF(CT.GT.20.) GO TO 440
      IF(S-.975.GT.0.) GO TO 420
      P5=P2
      P2=(P5+P3)/2.
      CT=CT+1.
      GO TO 290
  420 P3=P2
      P2=(P5+P3)/2.
      CT=CT+1.
      GO TO 290
  430 P1=0.
      P2=0.
  440 RETURN
      END
```

```
      SUBROUTINE POIS(XX,FR,XL,XU)
      DIMENSICN A(200),B(100),A1(200),B1(100)
      EQUIVALENCE (A(101),B(1)),
     *            (A1(101),B1(1))
      DATA A/ 00000, 0.051, 0.355, C.818, 1.366, 1.970, 2.613, 3.285,
     *        3.285, 4.460, 5.323, 5.323, 6.686, 6.686, 8.102, 8.102,
     *        9.598, 9.598,11.177,11.177,12.817,12.817,13.765,14.921,
     *       14.921,16.768,16.770,17.630,19.050,19.050,20.330,22.360,
     *       21.360,22.940,23.760,23.760,25.400,26.310,26.310,27.730,
     *       28.970,28.970,30.020,31.670,31.670,32.280,34.050,34.660,
     *       34.660,36.030,37.670,37.670,38.160,39.760,40.940,40.940,
     *       41.750,43.450,44.260,44.260,45.280,47.020,47.690,47.690,
     *       48.740,50.420,51.290,51.290,52.150,53.720,54.990,54.990,
     *       55.510,56.990,58.720,58.720,58.840,60.240,61.900,62.810,
     *       62.810,63.490,64.950,66.760,66.760,66.760,68.100,69.620,
     *       71.090,71.090,71.280,72.660,74.220,75.490,75.490,75.780,
     *       77.160,78.730,79.980,79.980/
      DATA B/ 80.25, 81.61, 83.14, 84.57, 84.57, 84.67, 86.01, 87.48,
     *        89.23, 89.23, 89.23, 90.37, 91.78, 93.48, 94.23, 94.23,
     *        94.70, 96.06, 97.54, 99.17, 99.17, 99.17,100.32,101.71,
     *       103.31,104.40,104.40,104.58,105.90,107.32,109.11,109.61,
     *       109.61,110.11,111.44,112.87,114.84,114.84,114.84,115.60,
     *       116.93,118.35,120.36,120.36,120.36,121.06,122.37,123.77,
     *       125.46,126.26,126.26,126.48,127.78,129.14,130.68,132.03,
     *       132.03,132.03,133.14,134.48,135.92,137.79,137.79,137.79,
     *       138.49,139.79,141.16,142.70,144.01,144.01,144.01,145.08,
     *       146.39,147.80,149.53,150.19,150.19,150.36,151.63,152.96,
     *       154.39,156.32,156.32,156.32,156.87,158.15,159.48,160.92,
     *       162.79,162.79,162.79,163.35,164.63,165.96,167.39,169.33,
     *       169.33,169.33,169.80,171.07/
      DATA A1/ 3.285, 5.323, 6.686, 8.102, 9.598,11.177,12.817,13.765,
     *        14.921,16.768,17.633,19.050,20.335,21.364,22.945,23.762,
     *        25.400,26.306,27.735,28.966,30.017,31.675,32.277,34.048,
     *        34.665,36.030,37.670,38.160,39.760,40.940,41.750,43.450,
     *        44.260,45.280,47.020,47.690,48.740,50.420,51.290,52.150,
     *        53.720,54.990,55.510,56.990,58.720,58.840,60.240,61.900,
     *        62.810,63.490,64.950,66.760,66.760,68.100,69.620,71.090,
     *        71.280,72.660,74.220,75.490,75.780,77.160,78.730,79.980,
     *        80.250,81.610,83.140,84.570,84.670,86.010,87.480,89.230,
     *        89.230,90.370,91.780,93.480,94.230,94.700,96.060,97.540,
     *        99.170,99.170,100.32,101.71,103.31,104.40,104.58,105.90,
     *        107.32,109.11,109.61,110.11,111.44,112.87,114.84,114.84,
     *        115.60,116.93,118.35,120.36/
      DATA B1/ 120.36,121.06,122.37,123.77,125.46,126.26,126.48,127.78,
     *         129.14,130.68,132.03,132.03,133.14,134.48,135.92,137.79,
     *         137.79,138.49,139.79,141.16,142.70,144.01,144.01,145.08,
     *         146.39,147.80,149.53,150.19,150.36,151.63,152.96,154.39,
     *         156.32,156.32,156.87,158.15,159.48,160.92,162.79,162.79,
     *         163.35,164.63,165.96,167.39,169.33,169.33,169.80,171.07,
     *         172.38,173.79,175.48,176.23,176.23,177.48,178.77,180.14,
     *         181.67,183.05,183.05,183.86,185.13,186.46,187.89,189.83,
     *         189.83,190.21,191.46,192.76,194.11,195.63,197.09,197.09,
     *         197.78,199.04,200.35,201.73,203.35,204.36,204.36,205.31,
     *         206.58,207.90,209.30,211.03,211.69,211.69,212.82,214.09,
     *         215.40,216.81,218.56,219.16,219.16,220.29,221.56,222.86,
     *         224.26,225.90,226.81,226.81/
      DEN=XX/FR
      NUM=XX+1.
      IF(NUM.GT.200) GC TO 1
      XL=A(NUM)/DEN
      XU=A1(NUM)/DEN
      GC TO 2
    1 XL=FR-1.96*SQRT(XX)/DEN
      XU=FR+1.96*SQRT(XX)/DEN
    2 RETURN
      END
```

V. DOMINANT LETHALITY IN HABROBRACON SPERM IN THE BIOSATELLITE II EXPERIMENT

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Anna R. Whiting
Katherine T. Cain
Joan W. Reel
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Julie T. Tindall
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The *Habrobracon juglandis* males that were carried in Biosatellite II were *lemon* mutants with sex allele composition of x^e and x^f. They were mated to Raleigh wild-type females (sex allele composition x^k/x^l) immediately after they were received from disassembly crews at Hickam Field. Males from the ground-based control setup at Cape Kennedy were mated at the same time.

The males were left together with the females during transport to Oak Ridge. Here they were separated and the cycles of egg laying initiated according to the procedured defined in the Standing Instructions (1967).

Results

The summarized egg-laying record from each female is presented in the print-out (pp. 26-85), along with the hatchability, adult survival, and the time of death for each offspring that died. A key to the symbols in the print-out is provided in Table 2.

The data are pooled for the animals coming from the upper left and lower right modules at each nominal exposure position. The data may still be separated by inspection of the print-out, since no more than 20 males were carried in each module. Numbering of the mated females began in units of 24. Thus the males in the upper left module (UL), as seen from the radiation source at the nominal exposure position of 4000 R, were given numbers 1-20. The males in the lower right module (LR) were numbered 25-42. The next group began at 49, etc.

Table 2. Explanation of symbols for data print-out

Category	Example	Explanation
DATE	11 SEP 67	
EXPERIMENT	BIOS B FLT	Spacecraft (or ground control)
EXPOSURE	4000	Nominal exposure position
FEMALE NOS	001 042	Numerical ordering of all females
SEX	M	Male (or female)
STOCKS TREATED	LE	Lemon mutant
MATED TO	R	Raleigh wild type
B		Brood number from which female was taken
F		Female
E		Number of eggs laid
H		Number of eggs hatched
1, 2, 3A, 3B, 4A, 4B, 5		Embryonic stage of death*
N, E, M, L, SL		Larval stage of death*
P, E, M, L		Pupal stage of death*
T		Number of transfers
UNMATED FEMALES		Number of females producing no female offspring
MATED FEMALES		Number of females producing female offspring
IN P		Inner compartment of packages; irradiated prior to launch
OUT		Outer and middle compartments of packages
PRETEST		Habrobracon tested at the time the animals were irradiated prior to being placed on spacecraft or in ground-based control setup

*See von Borstel, R. C., and R. H. Smith, 1967, Mutations in Habrobracon, ORNL-TM-1732, Quarterly Progress Report to NASA covering the period July 1 - September 30, 1966, pp. 1-8, for a complete description of the stages of death.

The data for hatchability and adult survival of unfertilized eggs were pooled from the females, at all positions in the satellite, that failed to mate. From these data and the data for mated females, the frequencies of fertilized eggs and their death, at every stage of development, were determined, (pp. 86-99).

Conclusion

Comparison of hatchabilities, adult survival, and their confidence limits show that when dominant lethality in sperm is the criterion, no significant difference exists between males that had been in the spacecraft and males that had been in the ground-based control setup.

The true exposures that were received by the Habrobracon are not the same as the nominal exposures (see von Borstel, Smith, Grosch, Whiting, et al., 1968, for some of the reasons). Nevertheless, this conclusion can be reached because the relative exposures received by the Habrobracon in the spacecraft and ground-based control setup, though not identical, were similar.

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. 29-247.

DATE	EXPERIMENT	EXPOSURE
11 SEP 67	B10S B FLT	4000

FEMALE NOS	SEX
001 042	M

STOCKS TREATED	MATED TO
LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
7	1	90.	65.	23.	0.0	0.0	0.0	1.	0.0	1.	1.	1.	0.0	0.0	1.	1.	1.	1.	0.0	37.	22.	0.0	0.0	8
8	2	80.	79.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	1.	0.0	2.	3.	70.	0.0	0.0	0.0	7
8	3	67.	35.	28.	0.0	2.	0.0	0.0	0.0	2.	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	15.	18.	0.0	0.0	7
8	4	66.	38.	23.	0.0	0.0	0.0	1.	2.	2.	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	20.	14.	0.0	0.0	8
8	5	63.	61.	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	4.	0.0	0.0	0.0	0.0	1.	0.0	0.0	56.	0.0	0.0	0.0	7
8	7	72.	43.	25.	0.0	3.	1.	0.0	0.0	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	24.	15.	0.0	0.0	8
7	8	70.	49.	20.	0.0	0.0	1.	0.0	0.0	0.0	2.	1.	0.0	0.0	2.	0.0	5.	0.0	0.0	20.	19.	0.0	0.0	8
8	9	46.	29.	8.	0.0	3.	1.	1.	3.	1.	0.0	3.	0.0	0.0	1.	0.0	3.	0.0	0.0	10.	12.	0.0	0.0	7
8	10	57.	55.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	1.	0.0	1.	1.	0.0	50.	0.0	0.0	0.0	7
8	11	64.	41.	21.	0.0	1.	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	3.	1.	3.	0.0	1.	12.	20.	0.0	0.0	8
31	12	85.	83.	2.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	4.	3.	0.0	74.	0.0	0.0	0.0	7
28	13	96.	68.	26.	0.0	0.0	1.	0.0	1.	0.0	1.	0.0	0.0	0.0	1.	0.0	3.	1.	1.	36.	25.	0.0	0.0	8
45	15	74.	72.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	2.	59.	9.	0.0	0.0	8
45	16	45.	41.	1.	0.0	2.	1.	0.0	0.0	0.0	1.	0.0	2.	0.0	4.	1.	0.0	0.0	1.	32.	0.0	0.0	0.0	7

14	17	57.	38.	15.	0.0	2.	1.	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.	15.	0.0	0.0	7
14	18	57.	39.	15.	0.0	0.0	0.0	1.	0.0	2.	2.	2.	0.0	2.	0.0	0.0	0.0	0.0	2.	13.	18.	0.0	0.0	7
14	19	83.	79.	0.0	0.0	2.	0.0	0.0	0.0	2.	2.	2.	2.	2.	1.	3.	0.0	2.	0.0	65.	0.0	0.0	0.0	6
207	20	55.	24.	24.	0.0	4.	2.	0.0	1.	0.0	1.	3.	1.	0.0	1.	0.0	0.0	0.0	0.0	9.	9.	0.0	0.0	7
8	25	81.	45.	34.	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	22.	21.	0.0	0.0	8
8	26	64.	59.	0.0	0.0	3.	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	1.	1.	55.	0.0	0.0	0.0	7
8	27	101.	64.	37.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	1.	0.0	1.	35.	25.	0.0	0.0	8
8	28	82.	79.	0.0	0.0	2.	0.0	0.0	1.	0.0	1.	1.	0.0	0.0	1.	1.	1.	0.0	0.0	74.	0.0	0.0	0.0	8
8	29	68.	67.	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	1.	63.	0.0	0.0	0.0	7
31	30	57.	34.	21.	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	1.	0.0	1.	15.	15.	0.0	0.0	8
31	31	94.	67.	25.	0.0	0.0	0.0	0.0	1.	1.	1.	3.	0.0	0.0	3.	1.	0.0	0.0	2.	31.	26.	0.0	0.0	8
31	32	68.	68.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	3.	0.0	10.	5.	4.	0.0	1.	41.	0.0	0.0	0.0	8
31	33	75.	74.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	7.	4.	1.	3.	0.0	58.	0.0	0.0	0.0	9
207	34	65.	32.	31.	0.0	0.0	1.	0.0	1.	0.0	0.0	6.	0.0	0.0	0.0	1.	0.0	0.0	0.0	15.	10.	0.0	0.0	8
207	35	70.	40.	27.	0.0	2.	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	6.	1.	1.	2.	0.0	14.	15.	0.0	0.0	8
207	36	61.	40.	21.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	2.	0.0	1.	0.0	16.	17.	0.0	0.0	8
207	37	93.	63.	27.	0.0	1.	0.0	0.0	2.	0.0	1.	2.	1.	0.0	0.0	0.0	0.0	1.	0.0	39.	19.	0.0	0.0	8
203	38	82.	53.	27.	0.0	0.0	0.0	0.0	1.	1.	0.0	1.	0.0	1.	2.	0.0	3.	1.	1.	26.	18.	0.0	0.0	8
40	39	64.	43.	18.	0.0	0.0	0.0	0.0	2.	1.	1.	0.0	0.0	1.	0.0	0.0	0.0	1.	2.	23.	15.	0.0	0.0	7
40	40	61.	38.	22.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	1.	18.	16.	0.0	0.0	7
40	41	8.	5.	0.0	0.0	2.	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	0.0	0.0	0.0	3
40	42	85.	63.	20.	0.0	2.	0.0	0.0	0.0	0.0	2.	6.	0.0	0.0	1.	1.	2.	3.	0.0	30.	18.	0.0	0.0	8

UNMATED FEMALES 11.

11 SEP67 B10S B FLT 4000

E	770.	1.000000
H	745.	0.967532
1	5.	0.006494
2	0.0	0.0
3A	12.	0.015584
3B	3.	0.003896
4A	1.	0.001299
4B	1.	0.001299
5	3.	0.003896
N	5.	0.006494
E	18.	0.023377
M	9.	0.011688
L	3.	0.003896
SL	24.	0.031169
P	16.	0.020779
E	13.	0.016883
M	12.	0.015584
L	7.	0.009091
	638.	0.828571
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.953208 0.978223

MATED FEMALES 25.

11 SEP67	BIOS B FLT		4000
E	1736.	1.000000	
H	1128.	0.649770	
1	538.	0.309908	
2	0.0	0.0	
3A	25.	0.014401	
3B	8.	0.004608	
4A	6.	0.003456	
4B	19.	0.010945	
5	12.	0.006912	
N	20.	0.011521	
E	34.	0.019585	
M	5.	0.002880	
L	4.	0.002304	
SL	27.	0.015553	
P	9.	0.005184	
E	25.	0.014401	
M	14.	0.008065	
L	15.	0.008641	
	564.	0.324885	
	411.	0.236751	

BINOMIAL CONF. LIMITS HATCH. 0.627329 0.672210

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B FLT	2000

FEMALE NOS	SEX
049 092	M

STOCKS TREATED MATED TO

LE R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
37	49	48.	41.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	1.	0.0	1.	3.	3.	0.0	7.	23.	0.0	0.0	6
37	50	46.	35.	10.	0.0	0.0	0.0	0.0	1.	0.0	1.	2.	0.0	2.	6.	2.	1.	3.	0.0	6.	12.	0.0	0.0	6
37	51	47.	37.	8.	0.0	1.	0.0	0.0	1.	0.0	1.	1.	1.	0.0	0.0	1.	0.0	0.0	0.0	14.	19.	0.0	0.0	6
37	52	60.	55.	0.0	0.0	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	53.	0.0	0.0	0.0	6
37	53	4.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	3.	0.0	0.0	0.0	1
37	54	54.	52.	1.	0.0	1.	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	6.	3.	1.	0.0	40.	0.0	0.0	0.0	6
13	55	52.	36.	16.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	18.	16.	0.0	0.0	6
13	56	56.	43.	13.	0.0	0.0	0.0	0.0	0.0	0.0	1.	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.	21.	0.0	0.0	6
13	57	40.	35.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.	21.	0.0	0.0	6
13	58	39.	29.	9.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	12.	16.	0.0	0.0	6
13	60	41.	35.	6.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	1.	0.0	0.0	0.0	20.	12.	0.0	0.0	5
13	61	52.	35.	16.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	1.	3.	0.0	0.0	9.	20.	0.0	0.0	6
13	62	28.	18.	10.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.	12.	0.0	0.0	5
13	63	51.	49.	0.0	0.0	0.0	0.0	0.0	2.	0.0	2.	1.	2.	0.0	0.0	2.	0.0	0.0	1.	41.	0.0	0.0	0.0	6
13	64	53.	42.	9.	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	1.	1.	1.	6.	2.	6.	0.0	14.	11.	0.0	0.0	6

40	65	52.	41.	10.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	1.	15.	22.	0.0	0.0	5
40	66	13.	6.	6.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	5.	0.0	0.0	4
40	67	60.	46.	13.	0.0	1.	0.0	0.0	0.0	0.0	1.	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	21.	21.	0.0	0.0	6
40	68	24.	19.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.	12.	0.0	0.0	4
208	74	39.	38.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	5.	0.0	1.	3.	1.	3.	0.0	0.0	25.	0.0	0.0	0.0	5
208	75	24.	24.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	23.	0.0	0.0	0.0	4
208	76	55.	48.	5.	0.0	0.0	0.0	1.	1.	0.0	0.0	4.	0.0	1.	0.0	1.	0.0	0.0	2.	9.	31.	0.0	0.0	5
208	77	56.	44.	11.	0.0	0.0	0.0	0.0	0.0	1.	0.0	4.	2.	0.0	1.	0.0	0.0	0.0	0.0	15.	22.	0.0	0.0	6
208	78	55.	47.	7.	0.0	0.0	1.	0.0	0.0	0.0	0.0	3.	1.	0.0	0.0	4.	0.0	0.0	0.0	12.	27.	0.0	0.0	6
13	79	39.	27.	11.	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	2.	0.0	9.	14.	0.0	0.0	5
9	80	59.	45.	10.	0.0	1.	0.0	0.0	1.	2.	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	1.	18.	23.	0.0	0.0	6
9	81	72.	57.	14.	0.0	1.	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	1.	0.0	0.0	1.	31.	21.	0.0	0.0	6
9	82	66.	51.	14.	0.0	0.0	0.0	0.0	1.	0.0	1.	5.	0.0	0.0	1.	0.0	0.0	0.0	0.0	16.	28.	0.0	0.0	6
40	83	53.	43.	10.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	1.	0.0	2.	0.0	0.0	1.	20.	16.	0.0	0.0	6
40	84	55.	43.	12.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	1.	0.0	0.0	2.	1.	0.0	0.0	18.	18.	0.0	0.0	6
202	85	42.	35.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	4.	3.	0.0	1.	1.	9.	16.	0.0	0.0	6
202	86	55.	45.	8.	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	2.	0.0	1.	1.	0.0	1.	2.	15.	23.	0.0	0.0	6
202	87	48.	37.	8.	0.0	1.	0.0	0.0	2.	0.0	1.	1.	0.0	0.0	4.	3.	0.0	3.	0.0	7.	18.	0.0	0.0	6
202	88	32.	24.	8.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	2.	0.0	0.0	2.	7.	11.	0.0	0.0	6
202	89	49.	42.	5.	0.0	0.0	0.0	0.0	1.	1.	0.0	5.	0.0	0.0	1.	1.	1.	1.	0.0	16.	17.	0.0	0.0	5
202	90	47.	35.	11.	0.0	0.0	0.0	0.0	1.	0.0	3.	1.	1.	2.	0.0	2.	0.0	0.0	0.0	14.	12.	0.0	0.0	6
202	91	42.	37.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	0.0	0.0	1.	1.	0.0	0.0	0.0	20.	11.	0.0	0.0	4
202	92	60.	37.	19.	0.0	1.	0.0	0.0	1.	2.	4.	6.	0.0	0.0	0.0	1.	0.0	0.0	0.0	7.	19.	0.0	0.0	6

UNMATED FEMALES 6.

11 SEP67 B10S B FLT 2000

E	232.	1.000000
H	222.	0.956897
1	1.	0.004310
2	0.0	0.0
3A	7.	0.030172
3B	0.0	0.0
4A	0.0	0.0
4B	2.	0.008621
5	0.0	0.0
N	4.	0.017241
E	6.	0.025862
M	2.	0.008621
L	1.	0.004310
SL	3.	0.012931
P	10.	0.043103
E	7.	0.030172
M	2.	0.008621
L	2.	0.008621
	185.	0.797414
	0.0	0.0

BINOMIAL CONF. LIMITS FATCH. 0.928692 0.979142

MATED FEMALES 32.

11 SEP67 B10S B FLT 2000

E	1536.	1.000000
H	1195.	0.777995
1	308.	0.200521
2	0.0	0.0
3A	7.	0.004557
3B	1.	0.000651
4A	1.	0.000651
4B	16.	0.010417
5	8.	0.005208
N	14.	0.009115
E	64.	0.041667
M	12.	0.007812
L	9.	0.005859
SL	20.	0.013021
P	39.	0.025391
E	12.	0.007812
M	21.	0.013672
L	11.	0.007161
	423.	0.275391
	570.	0.371094

BINOMIAL CONF. LIMITS HATCH. 0.757211 0.798779

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B FLT	1000

FEMALE NOS	SEX
097 140	M

STOCKS TREATED	MATED TO
LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
209	97	61.	54.	6.	0.0	0.0	0.0	1.	0.0	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	24.	26.	0.0	0.0	6
209	98	42.	34.	8.	0.0	0.0	0.0	0.0	0.0	0.0	1.	3.	0.0	0.0	0.0	3.	1.	0.0	1.	7.	18.	0.0	0.0	6
209	99	55.	51.	2.	0.0	2.	0.0	0.0	0.0	0.0	2.	4.	4.	0.0	0.0	1.	0.0	0.0	0.0	39.	1.	0.0	0.0	6
209	100	52.	45.	5.	0.0	0.0	2.	0.0	0.0	0.0	1.	5.	0.0	0.0	0.0	0.0	0.0	0.0	1.	11.	27.	0.0	0.0	6
209	102	65.	55.	9.	1.	0.0	0.0	0.0	0.0	0.0	2.	6.	1.	0.0	0.0	1.	0.0	0.0	0.0	13.	32.	0.0	0.0	6
209	103	54.	42.	8.	0.0	2.	0.0	0.0	2.	0.0	0.0	1.	0.0	0.0	0.0	1.	1.	0.0	0.0	15.	24.	0.0	0.0	6
206	104	36.	32.	3.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	1.	10.	19.	0.0	0.0	4
206	105	67.	61.	5.	0.0	0.0	0.0	0.0	1.	0.0	3.	5.	2.	0.0	0.0	1.	0.0	0.0	2.	18.	30.	0.0	0.0	6
43	106	16.	15.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	1.	0.0	0.0	2.	10.	0.0	0.0	2
202	107	48.	44.	2.	0.0	0.0	0.0	1.	1.	0.0	9.	4.	1.	0.0	0.0	0.0	0.0	0.0	0.0	8.	22.	0.0	0.0	5
202	108	41.	36.	4.	0.0	1.	0.0	0.0	0.0	0.0	2.	1.	2.	0.0	0.0	0.0	0.0	0.0	1.	8.	22.	0.0	0.0	6
202	109	48.	46.	1.	0.0	0.0	0.0	0.0	0.0	1.	1.	1.	0.0	1.	5.	2.	2.	5.	5.	7.	17.	0.0	0.0	6
202	110	29.	25.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	10.	12.	0.0	0.0	4
38	111	5.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	2
38	112	63.	59.	3.	0.0	1.	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	2.	4.	1.	2.	1.	12.	35.	0.0	0.0	6

201 113	66.	61.	5.	0.0	0.0	0.0	0.0	0.0	0.0	5.	3.	1.	0.0	2.	1.	0.0	1.	0.0	20.	28.	0.0	0.0	6
201 114	33.	32.	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	3.	0.0	1.	0.0	0.0	0.0	0.0	0.0	27.	0.0	0.0	0.0	4
201 115	44.	40.	3.	0.0	1.	0.0	0.0	0.0	0.0	0.0	11.	0.0	0.0	5.	2.	0.0	1.	1.	3.	17.	0.0	0.0	6
43 121	53.	51.	2.	0.0	0.0	0.0	0.0	0.0	0.0	2.	3.	0.0	0.0	0.0	2.	2.	1.	1.	11.	29.	0.0	0.0	6
43 122	64.	56.	5.	0.0	1.	0.0	0.0	2.	0.0	0.0	3.	6.	2.	3.	2.	0.0	1.	0.0	17.	22.	0.0	0.0	5
43 123	43.	39.	4.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	2.	1.	2.	0.0	17.	15.	0.0	0.0	6
44 124	54.	47.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.	27.	0.0	0.0	6
44 125	66.	56.	9.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	2.	0.0	1.	0.0	1.	0.0	0.0	21.	29.	0.0	0.0	6
44 126	76.	73.	0.0	0.0	3.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	2.	0.0	1.	68.	0.0	0.0	0.0	6
45 127	58.	45.	12.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	13.	30.	0.0	0.0	6
45 129	52.	45.	6.	0.0	0.0	0.0	0.0	1.	0.0	0.0	3.	1.	0.0	0.0	0.0	1.	0.0	0.0	13.	27.	0.0	0.0	6
45 130	67.	60.	5.	0.0	2.	0.0	0.0	0.0	0.0	0.0	2.	3.	0.0	0.0	3.	1.	1.	0.0	16.	34.	0.0	0.0	6
201 132	35.	35.	2.	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	7.	0.0	1.	0.0	13.	13.	0.0	0.0	6
201 133	42.	40.	1.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	3.	4.	6.	0.0	0.0	3.	21.	0.0	0.0	6
200 134	55.	48.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	1.	0.0	1.	0.0	9.	35.	0.0	0.0	6
200 135	53.	44.	9.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	1.	1.	2.	0.0	13.	25.	0.0	0.0	6
200 136	47.	45.	2.	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	1.	0.0	0.0	5.	1.	1.	1.	8.	25.	0.0	0.0	6
200 137	46.	42.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	2.	0.0	2.	1.	16.	20.	0.0	0.0	5
200 138	57.	54.	2.	0.0	1.	0.0	0.0	0.0	0.0	1.	2.	1.	0.0	0.0	3.	0.0	1.	1.	13.	32.	0.0	0.0	6
200 139	52.	44.	4.	0.0	2.	0.0	0.0	2.	0.0	1.	1.	1.	0.0	0.0	1.	0.0	0.0	2.	11.	27.	0.0	0.0	6
200 140	56.	45.	10.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	1.	0.0	1.	0.0	12.	30.	0.0	0.0	6

UNMATED FEMALES 3.

11 SEP67 B10S B FLT 1000

E	114.	1.000000
H	110.	0.964912
1	0.0	0.0
2	0.0	0.0
3A	4.	0.035088
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	2.	0.017544
E	6.	0.052632
M	0.0	0.0
L	1.	0.008772
SL	0.0	0.0
P	1.	0.008772
E	2.	0.017544
M	0.0	0.0
L	1.	0.008772
	97.	0.850877
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.914086 0.990354

MATED FEMALES 33.

11 SEP67 B10S B FLT 1000

E	1691.	1.000000
H	1496.	0.884684
1	160.	0.094619
2	1.	0.000591
3A	15.	0.008870
3B	2.	0.001183
4A	3.	0.001774
4B	13.	0.007688
5	1.	0.000591
N	38.	0.022472
F	69.	0.040804
M	30.	0.017741
L	6.	0.003548
SL	21.	0.012419
P	54.	0.031934
E	21.	0.012419
M	24.	0.014193
L	20.	0.011827
	432.	0.255470
	781.	0.461857

BINOMIAL CONF. LIMITS HATCH. 0.869460 0.899907

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B FLT	0500

FEMALE NOS	SEX
145 187	M

STOCKS	TREATED	MATED TO
	LF	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
3	145	37.	33.	3.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	3.	2.	1.	3.	0.0	2.	1.	5.	14.	0.0	0.0	6
3	146	40.	38.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	2.	0.0	0.0	0.0	10.	23.	0.0	0.0	6
3	147	62.	58.	3.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	5.	1.	3.	2.	18.	27.	0.0	0.0	6
3	148	44.	43.	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	3.	1.	2.	6.	5.	2.	3.	0.0	19.	0.0	0.0	0.0	6
3	149	63.	55.	6.	0.0	0.0	0.0	0.0	2.	0.0	0.0	2.	1.	0.0	3.	5.	0.0	4.	1.	12.	27.	0.0	0.0	6
3	150	53.	48.	3.	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	46.	0.0	0.0	0.0	6
3	151	82.	82.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	2.	1.	1.	4.	11.	0.0	9.	1.	41.	10.	0.0	0.0	7
3	152	59.	53.	6.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	1.	2.	1.	2.	13.	32.	0.0	0.0	6
3	153	53.	47.	6.	0.0	0.0	0.0	0.0	0.0	0.0	3.	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	10.	32.	0.0	0.0	6
3	154	57.	53.	2.	0.0	0.0	0.0	1.	1.	0.0	1.	3.	2.	1.	1.	5.	1.	1.	0.0	5.	33.	0.0	0.0	6
200	155	63.	56.	5.	0.0	1.	0.0	0.0	1.	0.0	0.0	5.	0.0	0.0	1.	0.0	3.	0.0	0.0	17.	30.	0.0	0.0	6
198	156	57.	54.	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	1.	0.0	0.0	0.0	1.	0.0	0.0	30.	17.	0.0	0.0	6
198	157	54.	50.	3.	0.0	0.0	0.0	1.	0.0	0.0	0.0	3.	1.	0.0	0.0	3.	2.	0.0	0.0	12.	29.	0.0	0.0	6
198	158	48.	43.	0.0	0.0	4.	0.0	1.	0.0	0.0	2.	2.	1.	1.	4.	2.	0.0	0.0	0.0	17.	14.	0.0	0.0	6
194	160	58.	53.	2.	0.0	1.	0.0	1.	1.	0.0	1.	8.	0.0	0.0	0.0	2.	0.0	0.0	0.0	13.	29.	0.0	0.0	6

34	161	57.	51.	4.	0.0	2.	0.0	0.0	0.0	0.0	1.	3.	1.	0.0	0.0	1.	4.	0.0	1.	11.	29.	0.0	0.0	6
35	162	66.	58.	7.	0.0	1.	0.0	0.0	0.0	0.0	1.	8.	1.	0.0	2.	2.	1.	0.0	0.0	16.	27.	0.0	0.0	6
35	163	49.	47.	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	2.	1.	0.0	2.	2.	1.	2.	1.	15.	21.	0.0	0.0	5
1	169	66.	59.	5.	0.0	1.	0.0	0.0	1.	0.0	0.0	3.	0.0	0.0	0.0	1.	0.0	0.0	1.	25.	29.	0.0	0.0	7
46	170	88.	83.	3.	0.0	0.0	0.0	1.	1.	0.0	3.	13.	1.	9.	5.	2.	3.	0.0	3.	21.	23.	0.0	0.0	8
46	171	4.	3.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	2.	0.0	0.0	3
46	172	73.	70.	2.	0.0	0.0	0.0	0.0	1.	0.0	2.	6.	1.	0.0	6.	5.	3.	0.0	1.	14.	32.	0.0	0.0	6
46	173	62.	57.	2.	0.0	1.	1.	0.0	0.0	1.	1.	1.	1.	1.	0.0	1.	0.0	3.	1.	11.	37.	0.0	0.0	7
45	174	77.	73.	3.	0.0	0.0	0.0	0.0	1.	0.0	1.	6.	1.	0.0	0.0	1.	3.	0.0	0.0	23.	38.	0.0	0.0	8
45	175	62.	61.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	1.	2.	2.	0.0	54.	0.0	0.0	0.0	7
45	176	73.	68.	4.	0.0	0.0	1.	0.0	0.0	0.0	1.	1.	0.0	0.0	1.	2.	0.0	8.	0.0	28.	27.	0.0	0.0	8
45	177	66.	63.	2.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	1.	0.0	1.	0.0	1.	58.	0.0	0.0	0.0	7
45	178	72.	68.	4.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	27.	38.	0.0	0.0	7
35	179	84.	84.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	6.	0.0	0.0	4.	2.	0.0	0.0	0.0	28.	42.	0.0	0.0	8
35	180	82.	77.	4.	0.0	0.0	0.0	0.0	1.	0.0	5.	3.	1.	0.0	6.	1.	3.	0.0	0.0	25.	33.	0.0	0.0	8
35	181	71.	67.	3.	0.0	0.0	0.0	0.0	1.	0.0	1.	3.	3.	2.	12.	10.	1.	0.0	1.	10.	24.	0.0	0.0	8
35	182	78.	68.	7.	0.0	1.	0.0	0.0	2.	0.0	0.0	1.	0.0	0.0	4.	4.	5.	2.	0.0	16.	36.	0.0	0.0	7
33	183	65.	60.	4.	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	2.	2.	1.	4.	0.0	0.0	23.	27.	0.0	0.0	8
33	184	71.	63.	6.	0.0	1.	0.0	1.	0.0	0.0	1.	2.	3.	0.0	3.	0.0	2.	0.0	0.0	27.	25.	0.0	0.0	8
33	186	78.	73.	3.	0.0	1.	0.0	0.0	1.	0.0	1.	2.	0.0	0.0	1.	4.	3.	2.	2.	30.	28.	0.0	0.0	8
33	187	61.	56.	4.	0.0	1.	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.	34.	0.0	0.0	8

UNMATED FEMALES 4.

11 SEP67 B10S B FLT 0500

E	225.	1.000000
H	215.	0.955556
1	7.	0.031111
2	0.0	0.0
3A	3.	0.013333
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	2.	0.008889
E	8.	0.035556
M	1.	0.004444
L	2.	0.008889
SL	7.	0.031111
P	6.	0.026667
E	5.	0.022222
M	6.	0.026667
L	1.	0.004444
	177.	0.786667
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.926427 0.978472

MATED FEMALES 32.

11 SEP67 BIOS B FLT 0500

E	2010.	1.000000
H	1860.	0.925373
1	107.	0.053234
2	0.0	0.0
3A	16.	0.007960
3B	3.	0.001493
4A	6.	0.002985
4B	16.	0.007960
5	2.	0.000995
N	31.	0.015423
E	98.	0.048756
M	25.	0.012438
L	19.	0.009453
SL	65.	0.032338
P	79.	0.039303
E	44.	0.021891
M	38.	0.018905
L	18.	0.008955
	574.	0.285572
	869.	0.432338

BINOMIAL CONF. LIMITS HATCH. 0.912697 0.937184

DATE EXPERIMENT EXPOSURE

11 SEP67 B10S B FLT IN P 2000 UL

FEMALE NOS SEX

193 216 M

STOCKS TREATED MATED TO

LE R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
37	193	43.	26.	17.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	13.	11.	0.0	0.0	5
37	194	55.	36.	17.	0.0	0.0	0.0	0.0	1.	1.	4.	2.	0.0	0.0	1.	2.	1.	1.	1.	16.	8.	0.0	0.0	6
37	195	44.	27.	14.	0.0	1.	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	10.	15.	0.0	0.0	5
13	196	43.	27.	16.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	21.	0.0	0.0	6
13	197	21.	18.	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	2.	2.	4.	0.0	0.0	1.	3.	5.	0.0	0.0	4
13	198	62.	43.	17.	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	23.	19.	0.0	0.0	6
13	199	60.	40.	19.	0.0	1.	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	1.	1.	21.	14.	0.0	0.0	6
13	201	30.	30.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	0.0	0.0	0.0	1.	0.0	1.	0.0	24.	0.0	0.0	0.0	4
208	202	58.	54.	1.	0.0	2.	1.	0.0	0.0	0.0	0.0	3.	0.0	0.0	2.	2.	0.0	0.0	2.	42.	3.	0.0	0.0	6
208	203	8.	7.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	5.	0.0	0.0	1
5	204	42.	30.	8.	0.0	1.	1.	0.0	1.	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	10.	19.	0.0	0.0	6
5	205	40.	24.	15.	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.	12.	0.0	0.0	6
5	206	49.	46.	0.0	0.0	1.	0.0	0.0	1.	1.	0.0	2.	0.0	1.	0.0	2.	1.	2.	2.	31.	5.	0.0	0.0	5
17	207	55.	53.	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	2.	0.0	50.	0.0	0.0	0.0	6
17	208	64.	59.	2.	0.0	2.	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	0.0	57.	0.0	0.0	0.0	6
17	210	61.	42.	16.	0.0	1.	1.	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.	20.	0.0	0.0	6
17	211	56.	42.	14.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	1.	2.	0.0	1.	0.0	0.0	1.	13.	21.	0.0	0.0	6
17	212	62.	42.	20.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	1.	1.	15.	22.	0.0	0.0	6

UNMATED FEMALES 3.

11 SEP67	B10S B FLT	IN P	2000 UL
E	149.	1.000000	
H	142.	0.953020	
1	2.	0.013423	
2	0.0	0.0	
3A	2.	0.013423	
3B	2.	0.013423	
4A	1.	0.006711	
4B	0.0	0.0	
5	0.0	0.0	
N	0.0	0.0	
E	5.	0.033557	
M	0.0	0.0	
L	0.0	0.0	
SL	0.0	0.0	
P	3.	0.020134	
F	0.0	0.0	
M	3.	0.020134	
L	0.0	0.0	
	131.	0.879195	
	0.0	0.0	

BINOMIAL CONF. LIMITS HATCH. 0.908630 0.980914

MATED FEMALES 15.

11 SEP67	BIOS B FLT	IN P	2000 UL
E	704.	1.000000	
H	504.	0.715909	
1	177.	0.251420	
2	0.0	0.0	
3A	7.	0.009943	
3B	3.	0.004261	
4A	0.0	0.0	
4B	5.	0.007102	
5	8.	0.011364	
N	7.	0.009943	
E	15.	0.021307	
M	2.	0.002841	
L	5.	0.007102	
SL	6.	0.008523	
P	14.	0.019886	
E	3.	0.004261	
M	7.	0.009943	
L	9.	0.012784	
	236.	0.335227	
	200.	0.284091	

BINOMIAL CONF. LIMITS HATCH. 0.682595 0.749223

DATE	EXPERIMENT	EXPOSURE
11 SEP67	810S B FLT	0000

FEMALE NOS	SEX
217 331	M

STOCKS TREATED	MATED TO
LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
37	217	44.	44.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	10.	1.	0.0	2.	0.0	0.0	1.	0.0	25.	0.0	0.0	0.0	5
37	218	5.	8.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	0.0	0.0	1.	0.0	3.	0.0	0.0	1
37	219	48.	47.	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	6.	0.0	0.0	5.	2.	0.0	2.	2.	14.	15.	0.0	0.0	6
37	220	55.	54.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	5.	6.	3.	1.	4.	1.	2.	0.0	32.	0.0	0.0	0.0	6
13	221	54.	52.	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	2.	1.	1.	0.0	0.0	0.0	0.0	3.	13.	32.	0.0	0.0	6
13	222	46.	46.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	14.	29.	0.0	0.0	6
208	223	54.	51.	0.0	0.0	2.	0.0	0.0	1.	0.0	0.0	5.	1.	1.	5.	9.	0.0	0.0	1.	6.	23.	0.0	0.0	6
208	224	41.	40.	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	36.	0.0	0.0	0.0	5
208	226	44.	41.	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	1.	0.0	2.	0.0	35.	0.0	0.0	0.0	6
1	227	54.	51.	2.	0.0	1.	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	1.	3.	0.0	0.0	2.	43.	0.0	0.0	0.0	6
1	228	45.	44.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	0.0	2.	1.	38.	0.0	0.0	0.0	5
33	229	48.	47.	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	7.	1.	2.	0.0	4.	1.	3.	1.	7.	19.	0.0	0.0	5
33	230	58.	54.	0.0	0.0	4.	0.0	0.0	0.0	0.0	4.	2.	0.0	1.	5.	5.	0.0	5.	3.	29.	0.0	0.0	0.0	6
33	231	53.	52.	0.0	0.0	0.0	0.0	0.0	1.	0.0	5.	5.	0.0	1.	0.0	3.	3.	1.	0.0	28.	6.	0.0	0.0	6
33	232	59.	58.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	1.	0.0	2.	18.	35.	0.0	0.0	6
33	233	44.	40.	1.	0.0	1.	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	37.	0.0	0.0	0.0	6

17 234	43.	42.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	3.	0.0	1.	2.	1.	0.0	0.0	19.	15.	0.0	0.0	6
17 235	43.	36.	7.	0.0	0.0	0.0	0.0	0.0	0.0	1.	4.	0.0	3.	1.	5.	0.0	1.	0.0	4.	17.	0.0	0.0	6
17 236	68.	67.	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	3.	2.	0.0	1.	3.	0.0	3.	3.	20.	31.	0.0	0.0	6
41 241	67.	67.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	3.	0.0	1.	3.	1.	2.	4.	26.	22.	0.0	0.0	6
41 242	37.	34.	1.	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	2.	2.	0.0	0.0	3.	7.	20.	0.0	0.0	5
41 243	7.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	4.	0.0	0.0	1
41 244	57.	56.	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	2.	0.0	0.0	0.0	1.	1.	0.0	0.0	51.	0.0	0.0	0.0	6
41 245	42.	40.	1.	0.0	1.	0.0	0.0	0.0	0.0	2.	3.	0.0	0.0	0.0	1.	0.0	2.	0.0	32.	0.0	0.0	0.0	6
31 246	48.	48.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.	0.0	0.0	1.	0.0	0.0	1.	2.	38.	0.0	0.0	0.0	6
41 247	58.	54.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	4.	3.	0.0	0.0	6.	39.	0.0	0.0	0.0	6
31 248	52.	52.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	3.	1.	0.0	5.	5.	1.	2.	1.	14.	19.	0.0	0.0	6
31 249	49.	47.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	1.	1.	0.0	0.0	1.	14.	28.	0.0	0.0	6
31 250	60.	60.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	1.	0.0	56.	0.0	0.0	0.0	6
31 251	35.	34.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	1.	2.	1.	1.	27.	0.0	0.0	0.0	4
31 252	47.	46.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	44.	0.0	0.0	0.0	6
31 253	56.	56.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	1.	1.	0.0	2.	2.	47.	0.0	0.0	0.0	6
7 254	62.	56.	4.	0.0	2.	0.0	0.0	0.0	0.0	0.0	8.	0.0	0.0	0.0	1.	1.	0.0	0.0	15.	31.	0.0	0.0	6
7 255	48.	48.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	14.	30.	0.0	0.0	6
7 256	54.	53.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	0.0	0.0	0.0	1.	0.0	0.0	0.0	18.	30.	0.0	0.0	5
7 257	61.	60.	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	2.	0.0	1.	1.	0.0	0.0	0.0	1.	10.	44.	0.0	0.0	6
15 265	56.	53.	1.	0.0	0.0	0.0	1.	0.0	1.	0.0	1.	2.	0.0	0.0	4.	0.0	0.0	0.0	14.	32.	0.0	0.0	6
15 266	66.	64.	2.	0.0	0.0	0.0	0.0	0.0	0.0	1.	7.	2.	0.0	0.0	1.	0.0	0.0	1.	18.	34.	0.0	0.0	6
15 267	43.	43.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	1.	0.0	2.	0.0	12.	26.	0.0	0.0	6
15 268	40.	36.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	2.	1.	1.	0.0	10.	20.	0.0	0.0	6
32 269	60.	57.	1.	0.0	2.	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	1.	0.0	1.	0.0	16.	36.	0.0	0.0	6
32 270	52.	52.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	22.	27.	0.0	0.0	6

212	271	65.	63.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	5.	1.	1.	0.0	17.	36.	0.0	0.0	6
212	272	61.	60.	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	1.	0.0	1.	3.	6.	2.	1.	2.	11.	32.	0.0	0.0	6
212	273	41.	41.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	5.	5.	0.0	2.	0.0	10.	16.	0.0	0.0	6
18	275	33.	33.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.	27.	0.0	0.0	5
6	276	53.	52.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	1.	12.	36.	0.0	0.0	6
6	277	61.	60.	0.0	0.0	1.	0.0	0.0	0.0	0.0	2.	2.	0.0	1.	0.0	4.	0.0	1.	3.	17.	30.	0.0	0.0	5
6	278	52.	52.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	2.	0.0	1.	1.	8.	0.0	3.	2.	11.	22.	0.0	0.0	6
6	280	54.	53.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	1.	0.0	0.0	6.	0.0	3.	1.	16.	25.	0.0	0.0	6
6	281	48.	48.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	2.	3.	5.	2.	2.	0.0	11.	21.	0.0	0.0	6
6	282	43.	42.	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	5.	1.	0.0	1.	3.	0.0	2.	1.	15.	13.	0.0	0.0	6
41	289	38.	38.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	3.	0.0	1.	0.0	13.	20.	0.0	0.0	3
41	290	59.	57.	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	3.	0.0	1.	0.0	3.	1.	1.	2.	46.	0.0	0.0	0.0	6
41	291	57.	54.	2.	0.0	0.0	1.	0.0	0.0	0.0	0.0	10.	4.	0.0	0.0	2.	3.	0.0	0.0	35.	0.0	0.0	0.0	6
41	292	40.	38.	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	6.	0.0	1.	0.0	9.	22.	0.0	0.0	6
41	293	60.	59.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	2.	1.	1.	52.	1.	0.0	0.0	6
41	294	56.	54.	0.0	0.0	2.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.	0.0	0.0	0.0	6
31	295	55.	55.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	1.	0.0	52.	0.0	0.0	0.0	6
31	296	51.	50.	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	10.	2.	1.	1.	34.	0.0	0.0	0.0	6
31	297	57.	56.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	4.	0.0	2.	2.	5.	2.	1.	10.	26.	0.0	0.0	6
6	298	59.	58.	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	9.	2.	0.0	0.0	2.	1.	2.	0.0	20.	21.	0.0	0.0	6
6	300	34.	33.	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	2.	2.	0.0	3.	3.	0.0	2.	2.	4.	14.	0.0	0.0	5
6	301	42.	35.	0.0	0.0	1.	0.0	2.	0.0	4.	0.0	1.	0.0	0.0	0.0	3.	0.0	1.	0.0	15.	15.	0.0	0.0	5
19	302	48.	45.	1.	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	3.	0.0	1.	2.	13.	25.	0.0	0.0	6
19	303	45.	43.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	1.	0.0	1.	0.0	15.	24.	0.0	0.0	6
19	304	51.	49.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	5.	1.	0.0	7.	6.	0.0	5.	3.	8.	14.	0.0	0.0	5
19	305	66.	63.	1.	0.0	0.0	1.	0.0	0.0	1.	0.0	6.	1.	2.	4.	4.	8.	2.	1.	11.	24.	0.0	0.0	6
19	306	45.	41.	3.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	0.0	3.	2.	0.0	2.	8.	24.	0.0	0.0	6
19	307	45.	46.	0.0	0.0	2.	0.0	1.	0.0	0.0	0.0	3.	0.0	0.0	0.0	3.	3.	0.0	1.	9.	27.	0.0	0.0	6
19	308	69.	68.	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	1.	2.	0.0	8.	1.	2.	0.0	17.	36.	0.0	0.0	6

7 313	70.	68.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	7.	2.	0.0	0.0	0.0	0.0	0.0	1.	22.	36.	0.0	0.0	6
8 314	66.	66.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	0.0	2.	0.0	1.	2.	1.	0.0	22.	33.	0.0	0.0	6
8 315	31.	30.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	2.	26.	0.0	0.0	0.0	5
8 316	58.	57.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	5.	1.	0.0	0.0	0.0	1.	0.0	0.0	24.	26.	0.0	0.0	6
8 317	32.	31.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	2.	2.	13.	12.	0.0	0.0	5
8 318	37.	36.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	1.	0.0	0.0	1.	16.	16.	0.0	0.0	6
8 319	54.	53.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	2.	0.0	0.0	0.0	2.	0.0	0.0	0.0	12.	37.	0.0	0.0	6
8 320	58.	56.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	1.	0.0	2.	0.0	0.0	15.	36.	0.0	0.0	6
8 321	45.	45.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	2.	0.0	0.0	0.0	0.0	1.	1.	16.	20.	0.0	0.0	6
8 322	42.	41.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	1.	0.0	0.0	0.0	1.	2.	10.	24.	0.0	0.0	6
8 323	23.	23.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	1.	1.	0.0	0.0	0.0	18.	0.0	0.0	0.0	6
36 324	55.	53.	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	4.	0.0	0.0	0.0	1.	0.0	0.0	0.0	12.	36.	0.0	0.0	6
19 325	54.	53.	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	5.	1.	0.0	0.0	1.	1.	1.	1.	6.	37.	0.0	0.0	6
19 326	60.	58.	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	4.	0.0	0.0	2.	2.	0.0	0.0	0.0	22.	28.	0.0	0.0	6
19 327	38.	36.	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	1.	1.	2.	0.0	0.0	0.0	8.	21.	0.0	0.0	6
19 328	50.	50.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.	1.	0.0	0.0	4.	2.	1.	0.0	8.	27.	0.0	0.0	6
119 329	14.	7.	1.	0.0	1.	0.0	1.	4.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	2.	3.	0.0	0.0	5
119 330	58.	56.	2.	0.0	0.0	0.0	0.0	0.0	0.0	2.	4.	2.	0.0	0.0	2.	0.0	0.0	0.0	18.	28.	0.0	0.0	6
119 331	53.	51.	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	3.	0.0	0.0	0.0	2.	1.	2.	0.0	14.	29.	0.0	0.0	6

UNMATED FEMALES 23.

11 SEP67 BIOS B FLT 0000

E	1120.	1.000000
H	1085.	0.968750
1	18.	0.016071
2	0.0	0.0
3A	12.	0.010714
3B	3.	0.002679
4A	0.0	0.0
4B	0.0	0.0
5	2.	0.001786
N	17.	0.015179
F	56.	0.050000
M	13.	0.011607
L	9.	0.008036
SL	18.	0.016071
P	42.	0.037500
E	11.	0.009821
M	22.	0.019643
L	24.	0.021429
	873.	0.779464
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.957420 0.978786

MATED FEMALES 67.

11 SEP67	BIOS B FLT		0000
E	3337.	1.000000	
H	3228.	0.967336	
I	46.	0.013785	
2	0.0	0.0	
3A	30.	0.008990	
3B	5.	0.001498	
4A	8.	0.002397	
4B	10.	0.002997	
5	10.	0.002997	
N	30.	0.008990	
E	186.	0.055739	
M	49.	0.014684	
L	22.	0.006593	
SL	57.	0.017081	
P	165.	0.049446	
E	47.	0.014085	
M	64.	0.019179	
L	55.	0.016482	
	925.	0.277195	
	1628.	0.487863	

BINOMIAL CONF. LIMITS HATCH. 0.960839 0.973260

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B GC1	4000

FEMALE NOS	SEX
337 380	M

STOCKS TREATED	MATED TO
LF	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
161	337	44.	28.	15.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	0.0	0.0	1.	2.	4.	1.	1.	9.	8.	0.0	0.0	6
161	338	21.	14.	6.	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	1.	7.	4.	0.0	0.0	4
147	339	40.	23.	15.	0.0	2.	0.0	0.0	0.0	0.0	2.	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.	7.	0.0	0.0	6
147	340	61.	41.	16.	0.0	2.	0.0	0.0	1.	1.	0.0	4.	1.	0.0	0.0	0.0	0.0	0.0	0.0	20.	16.	0.0	0.0	6
147	341	49.	32.	16.	0.0	1.	0.0	0.0	0.0	0.0	2.	0.0	1.	0.0	0.0	1.	2.	1.	0.0	11.	14.	0.0	0.0	6
147	342	41.	33.	7.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	2.	0.0	0.0	1.	26.	2.	0.0	0.0	5
147	343	63.	60.	1.	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	2.	0.0	1.	53.	3.	0.0	0.0	6
121	344	42.	29.	13.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	3.	0.0	16.	8.	0.0	0.0	6
121	345	54.	31.	22.	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	19.	10.	0.0	0.0	6
121	346	43.	20.	22.	0.0	0.0	0.0	0.0	1.	0.0	2.	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.	9.	0.0	0.0	6
121	347	38.	22.	14.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	3.	0.0	0.0	0.0	0.0	1.	1.	12.	5.	0.0	0.0	5
140	348	55.	34.	20.	0.0	0.0	0.0	0.0	0.0	1.	0.0	4.	0.0	1.	0.0	1.	0.0	1.	0.0	15.	12.	0.0	0.0	6
140	349	57.	35.	21.	0.0	1.	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	1.	20.	11.	0.0	0.0	6
140	350	59.	38.	18.	0.0	0.0	2.	0.0	0.0	1.	1.	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	19.	16.	0.0	0.0	6
140	351	51.	33.	14.	0.0	3.	0.0	0.0	0.0	1.	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	14.	16.	0.0	0.0	6
187	352	42.	19.	20.	0.0	2.	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	13.	5.	0.0	0.0	6

134	353	51.	38.	13.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	1.	0.0	0.0	1.	0.0	0.0	25.	8.	0.0	0.0	6
134	354	80.	78.	1.	0.0	1.	0.0	0.0	0.0	0.0	1.	9.	0.0	0.0	1.	0.0	0.0	0.0	1.	66.	0.0	0.0	0.0	6
134	355	51.	50.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	1.	0.0	1.	0.0	46.	0.0	0.0	0.0	5
134	356	37.	24.	11.	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	19.	3.	0.0	0.0	5
187	361	45.	22.	22.	0.0	0.0	0.0	0.0	1.	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	8.	10.	0.0	0.0	6
187	364	68.	47.	20.	0.0	0.0	0.0	0.0	1.	0.0	1.	1.	0.0	0.0	0.0	1.	0.0	0.0	1.	20.	23.	0.0	0.0	6
122	365	50.	29.	19.	0.0	1.	0.0	0.0	1.	0.0	0.0	1.	1.	0.0	0.0	1.	0.0	0.0	0.0	17.	9.	0.0	0.0	6
122	366	54.	33.	19.	0.0	0.0	0.0	0.0	1.	1.	1.	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	18.	11.	0.0	0.0	5
122	367	30.	15.	13.	0.0	1.	0.0	0.0	0.0	1.	0.0	3.	1.	1.	0.0	0.0	0.0	0.0	0.0	6.	4.	0.0	0.0	6
122	368	54.	33.	20.	0.0	0.0	0.0	0.0	0.0	1.	0.0	4.	0.0	0.0	0.0	1.	0.0	0.0	0.0	17.	11.	0.0	0.0	6
122	369	70.	40.	27.	0.0	0.0	0.0	0.0	2.	1.	1.	4.	0.0	0.0	0.0	4.	2.	1.	0.0	14.	14.	0.0	0.0	7
138	370	42.	32.	10.	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.	10.	0.0	0.0	5
138	371	56.	35.	18.	0.0	0.0	1.	0.0	2.	0.0	0.0	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.	16.	0.0	0.0	6
138	373	58.	31.	25.	0.0	1.	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	17.	11.	0.0	0.0	6
138	375	50.	28.	21.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	2.	14.	10.	0.0	0.0	6
134	376	44.	30.	12.	0.0	0.0	0.0	0.0	2.	0.0	0.0	2.	0.0	0.0	0.0	1.	1.	0.0	0.0	9.	17.	0.0	0.0	6
134	377	59.	34.	20.	0.0	0.0	0.0	0.0	4.	1.	1.	1.	1.	0.0	0.0	1.	0.0	0.0	1.	14.	15.	0.0	0.0	6
134	378	52.	34.	17.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.	14.	0.0	0.0	5
134	379	57.	46.	9.	0.0	1.	0.0	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.	14.	0.0	0.0	6
134	380	75.	56.	16.	0.0	1.	0.0	0.0	2.	0.0	0.0	6.	0.0	0.0	1.	1.	0.0	0.0	1.	34.	13.	0.0	0.0	6

UNMATED FEMALES 2.

11 SEP67 B10S B GCI 4000

F	131.	1.000000
H	128.	0.977099
1	1.	0.007634
2	0.0	0.0
3A	2.	0.015267
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	1.	0.007634
F	11.	0.083969
M	0.0	0.0
L	0.0	0.0
SL	1.	0.007634
P	1.	0.007634
E	0.0	0.0
M	1.	0.007634
L	1.	0.007634
	112.	0.854962
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.936961 0.995258

MATED FEMALES 34.

11 SEP67 B10S B GC1 4000

E	1712.	1.000000
H	1099.	0.641939
1	552.	0.322430
2	0.0	0.0
3A	22.	0.012850
3B	3.	0.001752
4A	1.	0.000584
4B	24.	0.014019
5	11.	0.006425
N	18.	0.010514
E	57.	0.033294
M	13.	0.007593
L	4.	0.002336
SL	5.	0.002921
P	19.	0.011098
E	13.	0.007593
M	11.	0.006425
L	13.	0.007593
	587.	0.342874
	359.	0.209696

BINOMIAL CONF. LIMITS HATCH. 0.619229 0.664650

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B GC1	2000

FEMALE NOS	SEX
385 428	M

STOCKS TREATED	MATED TO
LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
150	385	66.	48.	17.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	1.	0.0	1.	0.0	16.	28.	0.0	0.0	6
150	386	7.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	1.	4.	0.0	0.0	4
150	387	62.	47.	13.	0.0	1.	0.0	0.0	1.	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	17.	25.	0.0	0.0	6
150	388	78.	66.	9.	0.0	0.0	0.0	1.	1.	1.	0.0	9.	4.	0.0	0.0	2.	0.0	0.0	0.0	22.	29.	0.0	0.0	6
150	389	57.	49.	8.	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	2.	1.	0.0	2.	0.0	0.0	0.0	27.	14.	0.0	0.0	6
150	390	54.	37.	16.	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	1.	0.0	1.	3.	0.0	0.0	1.	15.	15.	0.0	0.0	6
146	392	58.	51.	6.	0.0	1.	0.0	0.0	0.0	0.0	1.	1.	0.0	1.	0.0	1.	0.0	0.0	0.0	29.	18.	0.0	0.0	6
146	394	53.	42.	8.	0.0	1.	2.	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	22.	16.	0.0	0.0	6
146	395	48.	42.	3.	0.0	1.	0.0	1.	1.	0.0	0.0	7.	0.0	0.0	0.0	2.	0.0	2.	6.	11.	14.	0.0	0.0	4
146	396	60.	43.	16.	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.	20.	0.0	0.0	6
146	397	57.	50.	5.	0.0	1.	0.0	0.0	1.	0.0	1.	2.	0.0	0.0	0.0	1.	0.0	0.0	1.	29.	16.	0.0	0.0	6
155	398	59.	45.	11.	0.0	1.	0.0	0.0	1.	1.	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	21.	21.	0.0	0.0	6
155	399	63.	59.	2.	0.0	1.	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	3.	0.0	0.0	4.	47.	4.	0.0	0.0	6
155	400	68.	55.	12.	0.0	0.0	0.0	0.0	0.0	1.	0.0	5.	0.0	0.0	1.	0.0	0.0	0.0	1.	33.	15.	0.0	0.0	6
155	401	64.	55.	6.	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	6.	0.0	0.0	1.	27.	21.	0.0	0.0	6
155	402	53.	52.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.	0.0	0.0	0.0	6
155	403	33.	32.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	30.	0.0	0.0	0.0	5
155	404	61.	54.	6.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.	27.	0.0	0.0	5

87	409	43.	42.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	2.	0.0	38.	0.0	0.0	0.0	5
87	410	35.	22.	10.	0.0	0.0	0.0	0.0	1.	2.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	10.	10.	0.0	0.0	6
87	411	51.	46.	1.	0.0	2.	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.	0.0	0.0	0.0	6
87	412	41.	32.	9.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	13.	17.	0.0	0.0	6
87	413	55.	55.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.	0.0	1.	5.	2.	1.	4.	1.	33.	0.0	0.0	0.0	5
87	414	74.	65.	5.	0.0	3.	0.0	0.0	1.	0.0	0.0	6.	1.	0.0	0.0	0.0	0.0	0.0	3.	20.	35.	0.0	0.0	6
87	415	42.	32.	9.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	3.	0.0	0.0	3.	0.0	0.0	1.	11.	14.	0.0	0.0	6
87	416	45.	37.	6.	0.0	1.	1.	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	25.	8.	0.0	0.0	5
130	417	60.	56.	0.0	0.0	2.	0.0	0.0	0.0	2.	0.0	0.0	1.	0.0	1.	1.	2.	3.	1.	47.	0.0	0.0	0.0	5
130	418	34.	25.	6.	0.0	0.0	0.0	1.	2.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	8.	14.	0.0	0.0	5
130	419	58.	45.	9.	0.0	2.	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	9.	6.	0.0	0.0	1.	12.	17.	0.0	0.0	6
130	420	53.	39.	13.	0.0	0.0	1.	0.0	0.0	0.0	1.	3.	1.	1.	0.0	1.	0.0	0.0	0.0	10.	22.	0.0	0.0	6
130	421	49.	37.	12.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	1.	3.	1.	0.0	1.	14.	15.	0.0	0.0	6
130	422	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1
130	423	44.	35.	7.	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	16.	17.	0.0	0.0	6
122	424	57.	55.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	3.	50.	0.0	0.0	0.0	6
122	425	14.	7.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	3.	0.0	0.0	2
91	426	45.	37.	6.	0.0	2.	0.0	0.0	0.0	0.0	1.	3.	1.	1.	1.	1.	1.	1.	0.0	13.	14.	0.0	0.0	6
60	427	71.	68.	1.	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	1.	1.	1.	7.	2.	54.	0.0	0.0	0.0	6
145	428	62.	48.	11.	1.	0.0	1.	0.0	0.0	1.	3.	0.0	0.0	2.	0.0	5.	1.	1.	0.0	14.	22.	0.0	0.0	6

UNMATED FEMALES 8.

11 SEP67 B10S B GC1 2000

E	423.	1.000000
H	406.	0.959811
1	4.	0.009456
2	0.0	0.0
3A	8.	0.018913
3B	1.	0.002364
4A	1.	0.002364
4B	1.	0.002364
5	2.	0.004728
N	0.0	0.0
E	13.	0.030733
M	3.	0.007092
L	2.	0.004728
SL	7.	0.016548
P	7.	0.016548
E	4.	0.009456
M	16.	0.037825
L	7.	0.016548
	347.	0.820331
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.937811 0.977310

MATED FEMALES 30.

11 SEP67	BIOS B GC1		2000
F	1512.	1.000000	
H	1211.	0.800926	
1	249.	0.164683	
2	1.	0.000661	
3A	17.	0.011243	
3B	6.	0.003968	
4A	3.	0.001984	
4B	13.	0.008598	
5	12.	0.007937	
N	16.	0.010582	
E	47.	0.031085	
M	16.	0.010582	
L	6.	0.003968	
SL	13.	0.008598	
P	42.	0.027778	
E	6.	0.003968	
M	8.	0.005291	
L	26.	0.017196	
	536.	0.354497	
	495.	0.327381	

BINOMIAL CONF. LIMITS HATCH. 0.780799 0.821053

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B GC1	1000

FEMALE NOS	SEX
433 476	M

STOCKS TREATED	MATED TO
LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
73	434	56.	49.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	6.	0.0	0.0	0.0	15.	25.	0.0	0.0	5
73	435	31.	26.	3.	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	2.	11.	11.	0.0	0.0	3
73	436	24.	19.	3.	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	3.	1.	0.0	0.0	0.0	0.0	0.0	7.	8.	0.0	0.0	3
73	437	63.	55.	5.	0.0	1.	0.0	0.0	1.	1.	0.0	4.	2.	0.0	1.	3.	0.0	0.0	0.0	18.	27.	0.0	0.0	5
73	438	55.	48.	7.	0.0	0.0	0.0	0.0	0.0	0.0	1.	3.	0.0	0.0	0.0	0.0	0.0	0.0	1.	23.	20.	0.0	0.0	5
76	439	46.	41.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	1.	0.0	1.	0.0	1.	1.	18.	17.	0.0	0.0	5
76	440	41.	37.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	0.0	0.0	0.0	12.	21.	0.0	0.0	5
76	441	35.	29.	4.	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	1.	13.	13.	0.0	0.0	5
78	442	8.	8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	3.	0.0	0.0	1
78	443	51.	44.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	2.	0.0	0.0	0.0	17.	24.	0.0	0.0	5
78	444	40.	34.	5.	0.0	0.0	0.0	0.0	0.0	1.	0.0	2.	0.0	0.0	2.	1.	0.0	4.	0.0	11.	14.	0.0	0.0	5
78	445	38.	32.	6.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	13.	18.	0.0	0.0	5
79	446	46.	38.	7.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	1.	0.0	0.0	3.	0.0	0.0	0.0	14.	18.	0.0	0.0	5
79	448	53.	45.	8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.	27.	0.0	0.0	5
79	449	50.	46.	2.	0.0	2.	0.0	0.0	0.0	0.0	1.	2.	3.	1.	0.0	0.0	0.0	0.0	0.0	15.	24.	0.0	0.0	5
103	450	46.	44.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	3.	2.	0.0	0.0	0.0	0.0	1.	0.0	38.	0.0	0.0	0.0	5
103	451	59.	53.	4.	0.0	0.0	0.0	0.0	2.	0.0	0.0	3.	1.	0.0	0.0	1.	1.	2.	0.0	24.	21.	0.0	0.0	5
103	452	52.	52.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	3.	3.	15.	28.	0.0	0.0	5

50	457	32.	28.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	8.	19.	0.0	0.0	6
54	458	55.	48.	6.	0.0	1.	0.0	0.0	0.0	0.0	1.	5.	0.0	0.0	0.0	1.	2.	3.	1.	23.	12.	0.0	0.0	6
54	459	50.	45.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	4.	1.	1.	0.0	12.	25.	0.0	0.0	6
54	460	44.	36.	8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	2.	0.0	12.	20.	0.0	0.0	5
59	461	67.	63.	4.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	2.	0.0	0.0	1.	0.0	1.	0.0	26.	31.	0.0	0.0	6
59	462	37.	31.	6.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	18.	11.	0.0	0.0	6
59	463	44.	41.	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	1.	0.0	0.0	1.	0.0	13.	24.	0.0	0.0	6
64	464	44.	29.	8.	0.0	4.	0.0	1.	1.	1.	0.0	5.	0.0	0.0	0.0	1.	0.0	0.0	0.0	14.	9.	0.0	0.0	6
64	465	65.	59.	6.	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	2.	0.0	1.	3.	0.0	3.	0.0	18.	29.	0.0	0.0	6
64	466	67.	62.	5.	0.0	0.0	0.0	0.0	0.0	0.0	6.	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	27.	27.	0.0	0.0	6
64	467	59.	54.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	1.	0.0	1.	0.0	14.	36.	0.0	0.0	6
64	468	43.	36.	5.	0.0	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	3.	0.0	2.	1.	11.	19.	0.0	0.0	4
67	469	37.	29.	6.	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	3.	0.0	2.	0.0	5.	17.	0.0	0.0	6
69	470	51.	44.	5.	0.0	1.	0.0	0.0	1.	0.0	5.	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	13.	23.	0.0	0.0	6
69	471	72.	63.	6.	0.0	2.	0.0	0.0	1.	0.0	1.	2.	4.	0.0	0.0	2.	0.0	0.0	0.0	21.	33.	0.0	0.0	6
69	472	82.	63.	10.	0.0	5.	0.0	0.0	3.	1.	0.0	3.	7.	0.0	0.0	1.	0.0	0.0	0.0	26.	26.	0.0	0.0	6
70	473	55.	52.	3.	0.0	0.0	0.0	0.0	0.0	0.0	1.	2.	0.0	0.0	0.0	3.	1.	0.0	0.0	20.	25.	0.0	0.0	5
70	474	68.	68.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	2.	0.0	0.0	3.	0.0	1.	0.0	61.	0.0	0.0	0.0	7
71	475	76.	70.	2.	0.0	4.	0.0	0.0	0.0	0.0	7.	0.0	2.	0.0	0.0	1.	0.0	0.0	0.0	45.	15.	0.0	0.0	6
72	476	54.	52.	2.	0.0	0.0	0.0	0.0	0.0	0.0	2.	2.	3.	0.0	1.	5.	0.0	0.0	0.0	27.	12.	0.0	0.0	6

UNMATED FEMALES 2.

11 SEP67 810S B GC1 1000

F	114.	1.000000
H	112.	0.982456
1	1.	0.008772
2	0.0	0.0
3A	1.	0.008772
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	0.0	0.0
F	4.	0.035088
M	4.	0.035088
L	0.0	0.0
SL	0.0	0.0
P	3.	0.026316
E	0.0	0.0
M	2.	0.017544
L	0.0	0.0
	99.	0.868421
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.939745 0.997866

MATED FEMALES 36.

11 SEP67 B10S B GC1 1000

E	1782.	1.000000
H	1561.	0.875982
1	176.	0.098765
2	0.0	0.0
3A	25.	0.014029
3B	1.	0.000561
4A	2.	0.001122
4B	10.	0.005612
5	7.	0.003928
N	28.	0.015713
E	53.	0.029742
M	34.	0.019080
L	6.	0.003367
SL	9.	0.005051
P	54.	0.030303
F	5.	0.002806
M	28.	0.015713
L	11.	0.006173
	601.	0.337262
	732.	0.410774

BINOMIAL CONF. LIMITS HATCH. 0.860678 0.891285

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B GC1	0500

FEMALE NOS	SEX
481 523	M

STOCKS	TREATED	MATED TO
	LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
81	481	58.	50.	8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	7.	1.	3.	1.	19.	17.	0.0	0.0	6
81	482	46.	40.	3.	0.0	1.	0.0	0.0	1.	1.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	15.	23.	0.0	0.0	6
81	483	60.	53.	4.	0.0	0.0	2.	0.0	1.	0.0	0.0	3.	2.	0.0	0.0	1.	0.0	1.	1.	22.	23.	0.0	0.0	6
81	484	41.	37.	2.	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	2.	1.	3.	4.	0.0	2.	0.0	9.	16.	0.0	0.0	5
81	485	65.	63.	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	4.	3.	0.0	0.0	2.	1.	1.	0.0	52.	0.0	0.0	0.0	6
129	486	51.	48.	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	4.	1.	1.	0.0	13.	27.	0.0	0.0	6
164	487	46.	43.	2.	0.0	1.	0.0	0.0	0.0	0.0	0.0	3.	0.0	1.	0.0	0.0	0.0	0.0	1.	17.	21.	0.0	0.0	6
164	488	47.	43.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	3.	0.0	0.0	0.0	1.	1.	0.0	20.	17.	0.0	0.0	6
156	489	57.	49.	8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	2.	0.0	0.0	0.0	19.	26.	0.0	0.0	6
172	490	54.	53.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	1.	2.	1.	16.	31.	0.0	0.0	6
165	491	63.	58.	4.	0.0	1.	0.0	0.0	0.0	0.0	0.0	4.	2.	1.	0.0	1.	0.0	1.	3.	21.	25.	0.0	0.0	6
165	492	49.	40.	9.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	5.	3.	2.	0.0	7.	21.	0.0	0.0	6
176	493	37.	35.	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	2.	3.	0.0	2.	1.	6.	19.	0.0	0.0	6
176	494	40.	39.	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	2.	0.0	1.	1.	4.	2.	3.	4.	6.	14.	0.0	0.0	6
176	495	49.	48.	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	2.	0.0	1.	0.0	1.	0.0	1.	1.	17.	24.	0.0	0.0	6
164	496	43.	39.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.	0.0	0.0	0.0	11.	23.	0.0	0.0	4
164	497	26.	23.	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	1.	0.0	0.0	0.0	19.	0.0	0.0	0.0	3
164	498	42.	39.	2.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	0.0	1.	1.	0.0	16.	18.	0.0	0.0	6

154 495	64.	60.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	21.	37.	0.0	0.0	6
154 500	52.	46.	6.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	1.	1.	0.0	0.0	18.	24.	0.0	0.0	6
85 505	54.	49.	4.	0.0	0.0	1.	0.0	0.0	0.0	0.0	2.	1.	1.	0.0	4.	0.0	1.	1.	20.	19.	0.0	0.0	6
85 506	43.	37.	1.	0.0	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	1.	0.0	0.0	1.	31.	1.	0.0	0.0	6
85 507	49.	41.	6.	0.0	0.0	0.0	0.0	0.0	2.	1.	3.	2.	0.0	7.	1.	0.0	2.	3.	8.	14.	0.0	0.0	6
126 509	40.	36.	2.	0.0	2.	0.0	0.0	0.0	0.0	0.0	4.	0.0	0.0	0.0	0.0	1.	0.0	1.	15.	15.	0.0	0.0	6
126 510	46.	37.	4.	0.0	4.	0.0	0.0	0.0	1.	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.	23.	0.0	0.0	6
126 511	47.	42.	4.	0.0	0.0	1.	0.0	0.0	0.0	0.0	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.	21.	0.0	0.0	6
126 512	70.	65.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.	3.	4.	2.	3.	0.0	0.0	0.0	12.	35.	0.0	0.0	6
88 513	39.	36.	2.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	2.	2.	0.0	0.0	0.0	11.	19.	0.0	0.0	6
88 514	48.	44.	2.	1.	1.	0.0	0.0	0.0	0.0	0.0	6.	1.	0.0	0.0	1.	0.0	0.0	0.0	22.	14.	0.0	0.0	6
88 515	34.	32.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	13.	17.	0.0	0.0	6
88 516	13.	13.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	4.	8.	0.0	0.0	1
115 517	53.	49.	3.	0.0	1.	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	1.	1.	16.	28.	0.0	0.0	6
115 518	49.	45.	4.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.	23.	0.0	0.0	6
115 519	44.	39.	3.	0.0	1.	0.0	0.0	0.0	1.	0.0	4.	0.0	3.	0.0	0.0	0.0	2.	0.0	6.	24.	0.0	0.0	6
94 520	64.	57.	3.	0.0	0.0	0.0	0.0	0.0	4.	0.0	1.	2.	0.0	0.0	1.	0.0	1.	0.0	16.	36.	0.0	0.0	6
94 521	47.	43.	3.	0.0	0.0	0.0	0.0	1.	0.0	0.0	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.	30.	0.0	0.0	6
81 522	54.	50.	4.	0.0	0.0	0.0	0.0	0.0	0.0	1.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.	25.	0.0	0.0	6
81 523	12.	11.	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	7.	0.0	0.0	5

UNMATED FEMALES 2.

11 SEP67 B10S B GC1 0500

E	91.	1.000000
H	86.	0.945055
1	0.0	0.0
2	0.0	0.0
3A	5.	0.054945
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	0.0	0.0
E	4.	0.043956
M	6.	0.065934
L	0.0	0.0
SL	0.0	0.0
P	3.	0.032967
E	1.	0.010989
M	1.	0.010989
L	0.0	0.0
	71.	0.780220
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.877162 0.981916

MATED FEMALES 36.

11 SEP67 B10S B GC1 0500

E	1705.	1.000000
H	1546.	0.906745
1	119.	0.069795
2	1.	0.000587
3A	21.	0.012317
3B	5.	0.002933
4A	0.0	0.0
4B	4.	0.002346
5	9.	0.005279
N	5.	0.002933
E	81.	0.047507
M	24.	0.014076
L	13.	0.007625
SL	20.	0.011730
P	51.	0.029912
E	14.	0.008211
M	27.	0.015836
L	22.	0.012903
	524.	0.307331
	765.	0.448680

BINOMIAL CONF. LIMITS HATCH. 0.892164 0.921126

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B GC3 IN P	2000

FEMALE NOS	SEX
601 620	M

STOCKS TREATED	MATED TO
LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
92	601	46.	36.	8.	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	2.	0.0	0.0	3.	16.	13.	0.0	0.0	6
92	602	29.	17.	12.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.	1.	2.	3.	0.0	0.0	0.0	0.0	1.	6.	0.0	0.0	6
92	603	74.	31.	39.	0.0	0.0	0.0	0.0	3.	1.	0.0	1.	0.0	0.0	1.	1.	0.0	0.0	0.0	10.	18.	0.0	0.0	6
92	604	52.	31.	19.	0.0	1.	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	15.	14.	0.0	0.0	6
91	605	49.	30.	19.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.	17.	0.0	0.0	6
91	606	41.	32.	9.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	1.	0.0	18.	11.	0.0	0.0	4
91	607	66.	65.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	5.	1.	0.0	1.	1.	0.0	3.	1.	53.	0.0	0.0	0.0	6
91	608	53.	38.	14.	0.0	0.0	0.0	0.0	0.0	1.	1.	3.	1.	0.0	2.	0.0	0.0	2.	1.	22.	6.	0.0	0.0	6
91	609	56.	39.	16.	0.0	1.	0.0	0.0	0.0	0.0	1.	1.	1.	0.0	1.	0.0	0.0	4.	0.0	22.	9.	0.0	0.0	6
91	610	62.	35.	27.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.	17.	0.0	0.0	6
93	611	55.	36.	15.	0.0	1.	0.0	0.0	3.	0.0	0.0	4.	0.0	0.0	5.	2.	0.0	1.	0.0	15.	9.	0.0	0.0	6
93	612	63.	42.	17.	0.0	0.0	0.0	0.0	2.	2.	1.	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	16.	22.	0.0	0.0	6
93	613	60.	38.	20.	0.0	0.0	0.0	0.0	1.	1.	0.0	3.	0.0	0.0	3.	4.	3.	3.	0.0	12.	10.	0.0	0.0	6
93	614	22.	15.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.	8.	0.0	0.0	5
93	615	20.	9.	11.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	7.	0.0	0.0	6
66	616	63.	43.	19.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.	16.	0.0	0.0	6
66	617	5.	5.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	2.	0.0	0.0	1
66	618	48.	32.	15.	0.0	0.0	0.0	0.0	1.	0.0	0.0	5.	0.0	0.0	0.0	0.0	0.0	0.0	1.	15.	11.	0.0	0.0	6
66	620	59.	41.	17.	0.0	0.0	0.0	0.0	1.	0.0	0.0	2.	0.0	1.	0.0	0.0	2.	0.0	0.0	14.	22.	0.0	0.0	6

UNMATED FEMALES 1.

11 SEP67 B10S B GC3 IN P 2000

E	66.	1.000000
H	65.	0.984848
1	0.0	0.0
2	0.0	0.0
3A	1.	0.015152
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	0.0	0.0
E	5.	0.075758
M	1.	0.015152
L	0.0	0.0
SL	1.	0.015152
P	1.	0.015152
E	0.0	0.0
M	3.	0.045455
L	1.	0.015152
	53.	0.803030
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.918963 0.999615

MATED FEMALES 18.

11 SEP67 BIOS B GC3 IN P 2000

E	857.	1.000000
H	550.	0.641774
1	284.	0.331389
2	0.0	0.0
3A	5.	0.005834
3B	0.0	0.0
4A	0.0	0.0
4B	13.	0.015169
5	5.	0.005834
N	4.	0.004667
E	35.	0.040840
M	5.	0.005834
I	3.	0.003501
SL	16.	0.018670
P	10.	0.011669
E	5.	0.005834
M	11.	0.012835
L	5.	0.005834
	238.	0.277713
	218.	0.254376

BINOMIAL CONF. LIMITS HATCH. 0.609671 0.673876

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B GC1 IN P	2000

FEMALE NOS	SEX
529 552	M

STOCKS TREATED	MATED TO
LF	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
75	529	43.	28.	12.	0.0	1.	0.0	1.	1.	0.0	3.	1.	0.0	0.0	0.0	1.	0.0	1.	0.0	15.	7.	0.0	0.0	6
75	530	50.	42.	8.	0.0	0.0	0.0	0.0	0.0	0.0	2.	2.	1.	1.	0.0	0.0	0.0	0.0	0.0	26.	10.	0.0	0.0	6
75	531	39.	34.	4.	0.0	1.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	17.	14.	0.0	0.0	6
75	532	61.	40.	21.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.	18.	0.0	0.0	6
75	533	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1
75	534	42.	24.	18.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.	15.	0.0	0.0	5
75	535	45.	28.	14.	0.0	0.0	0.0	0.0	3.	0.0	2.	2.	0.0	0.0	0.0	0.0	1.	0.0	0.0	16.	7.	0.0	0.0	6
75	536	56.	36.	18.	0.0	0.0	0.0	1.	0.0	1.	1.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.	10.	0.0	0.0	6
82	538	74.	49.	23.	0.0	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	24.	23.	0.0	0.0	6
82	539	65.	39.	25.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	3.	0.0	0.0	0.0	16.	18.	0.0	0.0	6
82	540	50.	34.	14.	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.	20.	0.0	0.0	6
82	541	55.	36.	19.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	1.	1.	6.	1.	1.	1.	6.	17.	0.0	0.0	6
82	543	52.	39.	13.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	3.	4.	3.	7.	0.0	0.0	0.0	12.	8.	0.0	0.0	6
86	544	63.	45.	15.	0.0	2.	0.0	1.	0.0	0.0	1.	2.	0.0	0.0	0.0	1.	0.0	0.0	0.0	21.	20.	0.0	0.0	6
86	545	65.	47.	15.	0.0	1.	0.0	0.0	1.	1.	0.0	2.	0.0	0.0	0.0	2.	0.0	0.0	0.0	29.	14.	0.0	0.0	6
86	546	43.	27.	15.	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	13.	12.	0.0	0.0	6
86	547	62.	38.	18.	0.0	1.	2.	3.	0.0	0.0	2.	1.	0.0	1.	0.0	1.	3.	1.	0.0	8.	21.	0.0	0.0	6

UNMATED FEMALES 1.

11 SEP67 B10S B GC1 IN P 2000

E	1.	1.000000
H	1.	1.000000
1	0.0	0.0
2	0.0	0.0
3A	0.0	0.0
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	0.0	0.0
E	0.0	0.0
M	0.0	0.0
L	0.0	0.0
SL	0.0	0.0
P	0.0	0.0
E	0.0	0.0
M	0.0	0.0
L	0.0	0.0
	1.	1.000000
	0.0	0.0

BINOMIAL CONF. LIMITS FATCH. 0.025016 1.000000

MATED FEMALES 16.

11 SFP67	B10S B GC1	IN P	20C0
E	865.	1.000000	
H	586.	0.677457	
1	252.	0.291329	
2	0.0	0.0	
3A	10.	0.011561	
3B	2.	0.002312	
4A	6.	0.006936	
4B	7.	0.008092	
5	2.	0.002312	
N	12.	0.013873	
E	21.	0.024277	
M	4.	0.004624	
L	8.	0.009249	
SL	4.	0.004624	
P	21.	0.024277	
E	5.	0.005780	
M	5.	0.005780	
L	2.	0.002312	
	270.	0.312139	
	234.	0.270520	

BINOMIAL CONF. LIMITS HATCH. 0.646305 0.708608

DATE	EXPERIMENT	EXPOSURE
11 SEP67	B10S B GC1 OUT	0000

FEMALE NOS	SEX
553 641	M

STOCKS TREATED	MATED TO
LF	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
83	553	65.	63.	0.0	0.0	1.	1.	0.0	0.0	0.0	1.	5.	2.	0.0	1.	3.	2.	2.	0.0	15.	32.	0.0	0.0	6
83	554	49.	47.	2.	0.0	0.0	0.0	0.0	0.0	0.0	2.	3.	3.	2.	0.0	0.0	1.	3.	0.0	16.	17.	0.0	0.0	6
83	555	54.	50.	2.	0.0	1.	1.	0.0	0.0	0.0	1.	0.0	1.	1.	0.0	3.	2.	0.0	0.0	15.	27.	0.0	0.0	6
83	556	56.	55.	1.	0.0	0.0	0.0	0.0	0.0	0.0	3.	1.	0.0	2.	1.	4.	2.	0.0	0.0	12.	30.	0.0	0.0	6
83	557	55.	53.	1.	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	0.0	0.0	0.0	0.0	19.	31.	0.0	0.0	6
83	558	41.	33.	0.0	0.0	5.	1.	1.	0.0	1.	2.	1.	1.	0.0	1.	4.	1.	2.	0.0	12.	9.	0.0	0.0	6
83	559	18.	14.	0.0	0.0	1.	1.	0.0	2.	0.0	2.	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	3.	7.	0.0	0.0	5
83	560	38.	38.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	12.	24.	0.0	0.0	6
83	561	62.	57.	2.	0.0	3.	0.0	0.0	0.0	0.0	1.	2.	1.	1.	2.	5.	2.	2.	0.0	17.	24.	0.0	0.0	6
83	564	45.	44.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.	28.	0.0	0.0	6
83	565	53.	50.	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	4.	1.	0.0	0.0	0.0	1.	0.0	0.0	18.	26.	0.0	0.0	6
83	566	34.	28.	0.0	0.0	0.0	0.0	4.	0.0	2.	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	1.	4.	21.	0.0	0.0	6
86	567	48.	45.	1.	0.0	1.	0.0	0.0	1.	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	18.	25.	0.0	0.0	6
86	571	50.	46.	1.	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	1.	1.	0.0	0.0	43.	0.0	0.0	0.0	6
86	572	52.	51.	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	2.	2.	0.0	0.0	12.	33.	0.0	0.0	6
147	577	50.	49.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	1.	19.	27.	0.0	0.0	6
147	578	49.	49.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	2.	0.0	0.0	1.	1.	1.	3.	14.	25.	0.0	0.0	5
147	579	43.	43.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	1.	12.	28.	0.0	0.0	6
147	580	50.	50.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	3.	0.0	0.0	1.	12.	32.	0.0	0.0	6
147	581	57.	54.	2.	0.0	0.0	0.0	0.0	0.0	1.	0.0	2.	1.	0.0	0.0	3.	0.0	0.0	0.0	23.	25.	0.0	0.0	6
147	582	62.	61.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.	35.	0.0	0.0	6
121	583	65.	64.	1.	0.0	0.0	0.0	0.0	0.0	0.0	2.	7.	0.0	0.0	0.0	1.	0.0	1.	0.0	11.	42.	0.0	0.0	6

121	584	52.	49.	1.	0.0	1.	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.	25.	0.0	0.0	6
121	585	66.	57.	5.	0.0	2.	0.0	0.0	2.	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	0.0	0.0	26.	29.	0.0	0.0	6
161	587	38.	38.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	1.	0.0	0.0	0.0	13.	22.	0.0	0.0	5
161	588	7.	7.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	5.	1.	0.0	0.0	1
161	589	72.	69.	1.	0.0	1.	0.0	0.0	1.	0.0	0.0	7.	1.	0.0	0.0	0.0	0.0	0.0	0.0	30.	31.	0.0	0.0	6
161	590	48.	48.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	16.	28.	0.0	0.0	5
140	591	55.	51.	2.	0.0	1.	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.	31.	0.0	0.0	6
140	592	55.	54.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	2.	0.0	0.0	1.	0.0	0.0	0.0	11.	39.	0.0	0.0	6
163	593	72.	71.	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	9.	1.	0.0	0.0	1.	0.0	3.	1.	17.	38.	0.0	0.0	6
163	594	59.	58.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	0.0	0.0	2.	8.	0.0	0.0	0.0	12.	33.	0.0	0.0	5
68	625	36.	36.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.	5.	8.	0.0	0.0	1.	0.0	0.0	2.	5.	8.	0.0	0.0	5
86	626	35.	35.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	1.	1.	0.0	0.0	0.0	0.0	0.0	2.	10.	19.	0.0	0.0	6
74	627	48.	44.	2.	0.0	2.	0.0	0.0	0.0	0.0	1.	2.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.	26.	0.0	0.0	6
74	628	59.	59.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	3.	0.0	1.	3.	1.	1.	1.	19.	28.	0.0	0.0	6
74	629	15.	14.	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	13.	0.0	0.0	2
74	630	59.	55.	1.	0.0	3.	0.0	0.0	0.0	0.0	0.0	7.	0.0	0.0	0.0	3.	2.	0.0	1.	9.	33.	0.0	0.0	6
74	631	55.	50.	1.	0.0	4.	0.0	0.0	0.0	0.0	2.	1.	0.0	0.0	0.0	1.	0.0	1.	0.0	16.	29.	0.0	0.0	6
74	632	51.	50.	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	4.	0.0	0.0	0.0	1.	0.0	0.0	1.	17.	26.	0.0	0.0	6
91	633	64.	62.	0.0	0.0	2.	0.0	0.0	0.0	0.0	2.	8.	1.	0.0	0.0	0.0	1.	2.	1.	19.	28.	0.0	0.0	6
74	634	59.	58.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	1.	0.0	1.	2.	21.	32.	0.0	0.0	6
74	635	31.	31.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	1.	0.0	0.0	0.0	18.	10.	0.0	0.0	5
74	636	36.	36.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	1.	0.0	0.0	0.0	0.0	0.0	3.	0.0	12.	17.	0.0	0.0	6
60	637	54.	54.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	7.	0.0	1.	1.	18.	26.	0.0	0.0	6
60	639	46.	45.	1.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.	1.	0.0	0.0	1.	0.0	1.	1.	20.	18.	0.0	0.0	6
91	640	56.	56.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	4.	0.0	0.0	1.	0.0	0.0	2.	1.	18.	28.	0.0	0.0	5
60	641	35.	35.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	1.	2.	0.0	2.	0.0	8.	20.	0.0	0.0	5

UNMATED FEMALES 1.

11 SEP67 B10S B GC1 OUT 0000

F	50.	1.000000
H	46.	0.920000
1	1.	0.020000
2	0.0	0.0
3A	3.	0.060000
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	0.0	0.0
E	0.0	0.0
M	1.	0.020000
L	0.0	0.0
SL	0.0	0.0
P	1.	0.020000
E	1.	0.020000
M	0.0	0.0
L	0.0	0.0
	43.	0.860000
	0.0	0.0

BINOMIAL CONF. LIMITS FATCH. 0.808144 0.977773

MATED FEMALES 47.

11 SEP 67 B10 S B GC1 OUT 0000

E	2309.	1.000000
H	2220.	0.961455
1	30.	0.012993
2	0.0	0.0
3A	36.	0.015591
3B	4.	0.001732
4A	6.	0.002599
4B	8.	0.003465
5	5.	0.002165
N	42.	0.018190
E	100.	0.043309
M	35.	0.015158
L	6.	0.002599
SL	10.	0.004331
P	68.	0.029450
E	19.	0.008229
M	28.	0.012126
L	24.	0.010394
	702.	0.304028
	1186.	0.513642

BINOMIAL CONF. LIMITS HATCH. 0.952746 0.969212

DATE	EXPERIMENT	EXPOSURE
7 SEP67	B10S B PRETEST	2000

FEMALE NOS	SEX
901 912	M

STOCKS TREATED	MATED TO
LE	R

B	F	E	H	1	2	3A	3B	4A	4B	5	N	E	M	L	SL	P	E	M	L					T
193	901	43.	27.	16.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.	12.	0.0	0.0	4
205	903	48.	35.	13.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.	17.	0.0	0.0	4
205	904	44.	30.	11.	0.0	1.	0.0	0.0	2.	0.0	0.0	0.0	1.	0.0	0.0	1.	0.0	0.0	0.0	18.	10.	0.0	0.0	4
189	905	40.	29.	10.	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	1.	0.0	17.	10.	0.0	0.0	4
189	907	46.	32.	14.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.	0.0	0.0	0.0	0.0	23.	7.	0.0	0.0	4
189	908	36.	19.	17.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	1.	0.0	6.	11.	0.0	0.0	4
207	909	51.	39.	11.	0.0	0.0	0.0	0.0	0.0	1.	1.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	23.	14.	0.0	0.0	4
207	911	34.	21.	12.	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	13.	7.	0.0	0.0	4
207	912	36.	19.	17.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.	0.0	0.0	0.0	11.	7.	0.0	0.0	4

UNMATED FEMALES 0.0

7 SEP67 B10S B PRETEST 2000

E	0.0	0.0
H	0.0	0.0
1	0.0	0.0
2	0.0	0.0
3A	0.0	0.0
3B	0.0	0.0
4A	0.0	0.0
4B	0.0	0.0
5	0.0	0.0
N	0.0	0.0
F	0.0	0.0
M	0.0	0.0
L	0.0	0.0
SL	0.0	0.0
P	0.0	0.0
E	0.0	0.0
M	0.0	0.0
L	0.0	0.0
	0.0	0.0
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.000000 0.000000

MATED FEMALES 9.

7 SEP67 B10S B PRETEST 2000

E	378.	1.000000
H	251.	0.664021
1	121.	0.320106
2	0.0	0.0
3A	2.	0.005291
3B	0.0	0.0
4A	0.0	0.0
4B	3.	0.007937
5	1.	0.002646
N	1.	0.002646
E	0.0	0.0
M	2.	0.005291
L	0.0	0.0
SL	2.	0.005291
P	5.	0.013228
E	0.0	0.0
M	2.	0.005291
L	0.0	0.0
	144.	0.380952
	95.	0.251323

BINOMIAL CONF. LIMITS FATCH. 0.616405 0.711638

67. TOTAL UNMATED FEMALES

7 SEP67 BIOS B PRETEST 2000

E	3486.	1.000000
H	3363.	0.964716
1	40.	0.011474
2	0.0	0.0
3A	60.	0.017212
3B	9.	0.002582
4A	3.	0.000861
4B	4.	0.001147
5	7.	0.002008
N	31.	0.008893
E	136.	0.039013
M	40.	0.011474
L	18.	0.005164
SL	61.	0.017499
P	94.	0.026965
E	44.	0.012622
M	68.	0.019507
L	44.	0.012622
	2827.	0.810958
	0.0	0.0

BINOMIAL CONF. LIMITS HATCH. 0.958382 0.970823

DOMINANT LETHALITY 67. UNMATED FEMALES 25. MATED FEMALES

11 SEP67 B10S B FLT 4000

D	0.560736
H	0.439264
1	0.509377
2	0.0
3A	0.012522
3B	0.005963
4A	0.005191
4B	0.017493
5	0.010190
N	0.013277
E	0.006600
M	-0.002864
L	0.000393
SL	0.014253
P	-0.009374
E	0.015590
M	0.000417
L	0.005979
	0.000000
	0.394992

PER CENT HAPLOID EGGS 40.06185

PER CENT MALES IN ADULTS 57.84615

CONFIDENCE LIMITS DOM. LETHALITY 0.530852 0.591146

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.408854 0.469148

CONFIDENCE LIMITS HAPLOID EGGS= 0.37730 0.42339

CONFIDENCE LIMITS MALES IN ADULTS 0.54747 0.60946

DOMINANT LETHALITY 67. UNMATED FEMALES 32. MATED FEMALES

11 SEP67 B10S B FLT 2000

D	0.318018
H	0.681982
1	0.297729
2	0.0
3A	-0.001950
3B	-0.000342
4A	0.000543
4B	0.015183
5	0.006854
N	0.009229
E	0.043031
M	0.005930
L	0.006217
SL	0.010718
P	0.024581
E	0.005339
M	0.010672
L	0.004354
	0.000000
	0.561911

PER CENT HAPLOID EGGS 33.95867

PER CENT MALES IN ADULTS 42.59819

CONFIDENCE LIMITS DOM. LETHALITY 0.288901 0.346208

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.653792 0.711099

CONFIDENCE LIMITS HAPLOID EGGS= 0.31616 0.36353

CONFIDENCE LIMITS MALES IN ADULTS 0.39523 0.45674

DOMINANT LETHALITY 67. UNMATED FEMALES 33. MATED FEMALES

11 SEP67 B10S B FLT 1000

D	0.152123
H	0.847377
1	0.132857
2	0.000863
3A	0.005034
3B	0.000539
4A	0.002194
4B	0.010696
5	-0.000060
N	0.028717
F	0.041628
M	0.020623
L	0.002805
SL	0.010082
P	0.034219
F	0.012325
M	0.011749
L	0.011462
	0.000000
	0.674266

PER CENT HAPLOID EGGS 31.50226

PER CENT MALES IN ADULTS 35.61418

CONFIDENCE LIMITS DOM. LETHALITY 0.131308 0.172664

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.827336 0.868692

CONFIDENCE LIMITS HAPLOID EGGS= 0.29305 0.33734

CONFIDENCE LIMITS MALES IN ADULTS 0.32919 0.38309

DOMINANT LETHALITY 67. UNMATED FEMALES 32. MATED FEMALES

11 SEP67 BIOS B FLT 0500

D	0.096012
H	0.903988
1	0.075932
2	0.0
3A	0.002932
3B	0.000900
4A	0.004140
4B	0.011663
5	0.000444
N	0.018972
E	0.054052
M	0.012961
I	0.011784
SL	0.040404
P	0.046010
F	0.026928
M	0.018579
L	0.006962
	0.000000
	0.667335

PER CENT HAPLOID EGGS 35.21417

PER CENT MALES IN ADULTS 39.77824

CONFIDENCE LIMITS DOM. LETHALITY 0.080184 0.113518

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.886482 0.919816

CONFIDENCE LIMITS HAPLOID EGGS= 0.33136 0.37312

CONFIDENCE LIMITS MALES IN ADULTS 0.37253 0.42304

DOMINANT LETHALITY 67. UNMATED FEMALES 15. MATED FEMALES

11 SEP67 B105 B FLT IN P 2000 UL

D	0.459415
H	0.540585
1	0.420500
2	0.0
3A	0.004821
3B	0.005445
4A	-0.000606
4B	0.011298
5	0.017956
N	0.010663
F	0.008830
M	-0.003243
I	0.008468
SL	0.002198
P	0.014898
F	-0.001630
M	0.003204
I	0.012898
	0.000000
	0.484278

PER CENT HAPLOID EGGS 41.33719

PER CENT MALES IN ADULTS 54.12844

CONFIDENCE LIMITS DOM. LETHALITY 0.411980 0.508117

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.491883 0.588020

CONFIDENCE LIMITS HAPLOID EGGS= 0.37698 0.44973

CONFIDENCE LIMITS MALES IN ADULTS 0.49451 0.58806

DOMINANT LETHALITY 67. UNMATED FEMALES 67. MATED FEMALES

11 SEP67 BIOS B FLT 0000

D	0.031303
H	0.968697
I	0.014985
2	0.0
3A	0.004720
3B	0.000936
4A	0.003195
4B	0.003957
5	0.003510
N	0.009041
E	0.064425
M	0.016351
L	0.007335
SL	0.016864
P	0.061120
F	0.014844
M	0.019009
L	0.018486
	0.000000
	0.741222

PER CENT HAPLOID EGGS 34.18118

PER CENT MALES IN ADULTS 36.23188

CONFIDENCE LIMITS DOM. LETHALITY 0.024463 0.039167

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.960833 0.975537

CONFIDENCE LIMITS HAPLOID EGGS= 0.32583 0.35802

CONFIDENCE LIMITS MALES IN ADULTS 0.34367 0.38096

DOMINANT LETHALITY 67. UNMATED FEMALES 34. MATED FEMALES

11 SEP67 B10S B GC1 4000

D	0.594496
H	0.405504
1	0.550206
2	0.0
3A	0.009656
3B	0.001145
4A	0.000382
4B	0.023447
5	0.009661
N	0.011702
E	0.029105
M	0.004751
L	0.000266
SL	-0.007758
P	-0.000524
E	0.003910
M	-0.003157
L	0.003910
	0.000000
	0.363300

PER CENT HAPLOID EGGS 42.28009

PER CENT MALES IN ADULTS 62.05074

CONFIDENCE LIMITS DOM. LETHALITY 0.563509 0.624750

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.375250 0.436491

CONFIDENCE LIMITS HAPLOIC EGGS= 0.39950 0.44630

CONFIDENCE LIMITS MALES IN ADULTS 0.58958 0.65143

DOMINANT LETHALITY 67. UNMATED FEMALES 30. MATED FEMALES

11 SEP67 B10S B GC1 2000

D	0.326277
H	0.673723
I	0.283667
2	0.001175
3A	0.006608
3B	0.005045
4A	0.002857
4B	0.014384
5	0.012541
N	0.011894
E	0.024927
M	0.009889
L	0.003040
SL	0.001685
P	0.028409
E	-0.002752
M	-0.005749
L	0.020748
	0.000000
	0.581632

PER CENT HAPLOID EGGS 43.71340

PER CENT MALES IN ADULTS 51.98836

CONFIDENCE LIMITS DOM. LETHALITY 0.295164 0.358185

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.641815 0.704836

CONFIDENCE LIMITS HAPLOID EGGS= 0.41217 0.46217

CONFIDENCE LIMITS MALES IN ADULTS 0.48939 0.55038

DOMINANT LETHALITY 67. UNMATED FEMALES 36. MATED FEMALES

11 SEP67 B10S 8 GC1 1000

D	0.187195
H	0.812805
1	0.160915
2	0.0
3A	0.011763
3B	-0.000877
4A	0.001309
4B	0.008790
5	0.005295
N	0.020568
E	0.023141
M	0.024494
L	0.002088
SL	-0.003812
P	0.032680
E	-0.004183
M	0.013011
L	0.001581
	0.000000
	0.703237

PER CENT HAPLOID EGGS 41.58803

PER CENT MALES IN ADULTS 45.08627

CONFIDENCE LIMITS DOM. LETHALITY 0.163616 0.211022

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.788578 0.836382

CONFIDENCE LIMITS HAPLOID EGGS= 0.39294 0.43871

CONFIDENCE LIMITS MALES IN ADULTS 0.42415 0.47757

DOMINANT LETHALITY 67. UNMATED FEMALES 36. MATED FEMALES

11 SEP67 BIOS B GC1 0500

D	0.128631
H	0.871369
1	0.105384
2	0.000944
3A	0.000330
3B	0.003147
4A	-0.000525
4B	0.003077
5	0.007274
N	-0.000705
E	0.052691
M	0.015664
L	0.009126
SL	0.008210
P	0.031710
E	0.005520
M	0.013596
L	0.013075
	0.000000
	0.722481

PER CENT HAPLOID EGGS 37.89732

PER CENT MALES IN ADULTS 40.65167

CONFIDENCE LIMITS DOM. LETHALITY 0.108273 0.148573

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.851427 0.891727

CONFIDENCE LIMITS HAPLOID EGGS= 0.35586 0.40191

CONFIDENCE LIMITS MALES IN ADULTS 0.37970 0.43333

DOMINANT LETHALITY 67. UNMATED FEMALES 47. MATED FEMALES

11 SEP67 B10S B GC1 OUT C000

D	0.040500
H	0.959500
1	0.013903
2	0.0
3A	0.014619
3B	0.001223
4A	0.003641
4B	0.004854
5	0.002260
N	0.023765
E	0.045885
M	0.017367
!	0.001060
SL	-0.003566
P	0.030940
E	0.005594
M	0.007700
L	0.009058
	0.000000
	0.821695

PER CENT HAPLOID EGGS 37.48994

PER CENT MALES IN ADULTS 37.18220

CONFIDENCE LIMITS DOM. LETHALITY 0.030672 0.051435

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.948566 0.969328

CONFIDENCE LIMITS HAPLOID EGGS= 0.35531 0.39480

CONFIDENCE LIMITS MALES IN ADULTS 0.35002 0.39362

DOMINANT LETHALITY 67. UNMATED FEMALES 16. MATED FEMALES

11 SEP67 B10S B GC1 IN P 2000

D	0.502297
H	0.497703
1	0.466450
2	0.0
3A	0.008025
3B	0.002143
4A	0.010738
4B	0.012438
5	0.002502
N	0.016989
E	0.015056
M	0.000638
L	0.011605
SL	-0.003432
P	0.022596
E	0.001499
M	-0.002809
L	-0.004139
	0.000000
	0.439800

PER CENT HAPLOID EGGS 38.49012

PER CENT MALES IN ADULTS 53.57143

CONFIDENCE LIMITS DOM. LETHALITY 0.459392 0.544368

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.455632 0.540608

CONFIDENCE LIMITS HAPLOID EGGS= 0.35254 0.41740

CONFIDENCE LIMITS MALES IN ADULTS 0.49217 0.57926

DOMINANT LETHALITY 67. UNMATED FEMALES 18. MATED FEMALES

11 SEP67 B10S B GC3 IN P 2000

D	0.526414
H	0.473586
1	0.497999
2	0.0
3A	-0.000091
3B	-0.001345
4A	-0.000448
4B	0.022472
5	0.007827
N	0.002467
F	0.041792
M	0.002897
L	0.002635
SL	0.019280
P	0.003702
E	0.002299
M	0.009361
L	0.002299
	0.000000
	0.386854

PER CENT HAPLOID EGGS 34.24504

PER CENT MALES IN ADULTS 52.19298

CONFIDENCE LIMITS DOM. LETHALITY 0.485389 0.567803

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.432197 0.514611

CONFIDENCE LIMITS HAPLOID EGGS= 0.31013 0.37365

CONFIDENCE LIMITS MALES IN ADULTS 0.47608 0.56778

DOMINANT LETHALITY 67. UNMATED FEMALES 9. MATED FEMALES

7 SEP67 B10S B PRETEST 2000

D	0.602372
H	0.397628
1	0.593530
2	0.0
3A	-0.005270
3B	-0.002287
4A	-0.000762
4B	0.013951
5	0.003210
N	-0.002889
F	-0.034563
M	-0.000187
L	-0.004574
SL	-0.005524
P	0.001057
E	-0.011182
M	-0.007303
L	-0.011182
	0.000000
	0.473976

PER CENT HAPLOID EGGS 46.97559

PER CENT MALES IN ADULTS 60.25105

CONFIDENCE LIMITS DOM. LETHALITY 0.529398 0.668016

CONFIDENCE LIMITS DIPLOID HATCHABILITY 0.331836 0.470605

CONFIDENCE LIMITS HAPLOID EGGS= 0.42058 0.52122

CONFIDENCE LIMITS MALES IN ADULTS 0.53823 0.66442

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