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PRELIMINARY RESULTS OF SCIENTIFIC RESEARCH ON BIOSATELLITE KOSMOS-1129

Soviet Health Ministry

Translation of "Predvaritel'nyye rezultaty nauchnykh issledovaniy na biosputnike "Kosmos-1129", Moscow, Ministry of Health USSR and the Institute of Medical and Biological Problems and the "Interkosmos" Council of the Academy of Sciences USSR, 1980, pp 1-37.

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16. Abstract The first or physiological study aimed at deeper examination of mechanisms of weightlessness and adaptation/readaptation. It dealt with metabolism, support-motor changes and nonspecific changes connected with stress reaction. Wistar rats were used in a triple setup: flight/vivarium/biosatellite mockup. Animal condition was assessed on motor activity and body temperature. Extensive Tables show weight, blood and enzyme analysis, etc. Animals groups were labeled: stress, behavior, body composition, biorhythm, ontogenesis. The second or biological study dealt with tumorous carrot tissue but humidity control was defective; some indices are reported such as cell membrane peremeability, tissue respiration, etc. It also was concerned with a fowl embryogenetic experiment (Japanese quail) but mechanical effects on landing reduced its success. The third study, on radiation dosimetry, presents a little tabulated data but chiefly gives lists of satellite detector units of different kinds and from different countries.

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PRELIMINARY RESULTS OF SCIENTIFIC RESEARCH ON BIOSATELLITE KOSMOS-1129

Soviet Health Ministry

I. Physiological Research /2*

The purpose of the physiological experiments on the biosatellite Kosmos-1129 was a more profound study of the mechanisms of adaptation to weightlessness and re-adaptation to Earth gravitation. The studies carried out dealt with metabolism, changes in the support-motor apparatus and nonspecific changes associated with the development of stress reaction during flight and following return to Earth. The program of animal observation on board the biosatellite was extended.

For the experiment we used Wistar rats obtained from the Slovak Academy of Science's Institute of Experimental Endocrinology (Bratislava). Selection and preparation of animals for flight was conducted in the usual way, that used in biosatellite experiments, and were complemented by training under standard maintenance conditions. The animals in the "biorhythym" experiment were equipped introperitoneally with body temperature monitors; those in the "behavior" experiment prior to flight were subjected to a special program that developed conditioned reflexes with food reinforcement. Just before flight animal age ranged from 84 to 86 days, average weight in the "stress" and "behavior" experiments was 290 g; in the "body composition" it was 314 g; in "biorhythm" 318 g. During flight most of the animals were kept in individual box cages of BIOS blocks similar to those used on previous biosatellites. The light day lasted 12 hr (8:00-20:00). In the course of 24 hr the animals received 40 g of pasty food in 4 portions. Air temperature in the area where the animals were kept ranged between 23.5 and 25.5°C and relative humidity was 55-65%; pO_2 was 135-212 mm Hg and pCO_2 was up to 6 mm Hg.

The flight lasted 18.5 days. The results obtained for animals in the flight group were compared with the vivarium control and with a synchronous Earth experiment in a biosatellite mockup, where the following physiologically significant flight factors were modeled. /3

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* Numbers in the margin indicate pagination in the foreign text.

In the launch phase:

- vibration,
- acceleration,
- noise.

During the experiment:

- maintenance of animals in cages with a life support system,
- providing of water and food according to a standard cyclogram,
- support of microclimate parameters similar to those in the biosatellite cabin during flight.

During landing:

- shock acceleration for animals in the "stress", "behavior" and "ontogenesis" experiments,
- acceleration associated with leaving orbit and earth landing for animals in the "biorhythm" and "body composition" experiments.

In respect to a number of indices an additional control was used in the form of preflight group LSS tests, during which maintenance conditions for the animals were practically the same as those in the synchronous control, but there was no modeling for factors associated with launching and landing.

Following the experiment the animals were sacrificed at 3 points: following hours 7-11 (group I), following day 6 (groups II and III) and following day 25 (group IV).

Animals of the flight group designated for a study of the period of readapta- /4
tion to Earth gravitation, as well as the corresponding animals of the control groups kept in the vivarium (at t = 22-25°C) were maintained in individual cages measuring 18x18x12.5 cm and were continued on the special diet with the 24 hr ration increased to 45 g. An exception were the animals in the "biorhythm" experiment (group IV), that were kept in groups of 5 in ordinary vivarium cages (55x19.5x33 cm). During hours 7-10 following landing and thereafter on days 3, 4, 5 and 6 of the re-adaptation period the animals of group III were subjected to a functional test -- 2.5 hr functional stress -- in the prone position. The first, second and third tests were accompanied by blood sampling (caudal) which was done before the test, at the

end of fixation and 30 min following the end of the test. A similar scheme was followed for testing animals of the synchronous and vivarium controls. The animals were decapitated on the day of the last stress test.

The condition of the animals during flight, as well as before flight, was assessed on the basis of motor activity and body temperature. In addition, data were first obtained on the dynamics of conditioned reflex activity changes ("behavior" experiment). All during the flight we noticed a reduction in the level of the conditions set up prior to flight for food reflexes in response to light stimulation. The changes observed were not univocal at various stages of the flight, but had a clearly pronounced phasic character that apparently reflected the dynamics of the adaptation process. During the first days we noted severe repression of conditioned reflexes and a change in force relationships based on anesthetic type. By days 4-6 the level of conditioned reflexes was clearly on the increase, although during the period days 7-12 it was dropping again but not as significantly as at the beginning of the experiment. In this context the force relationships were disturbed in respect to the type of equilibrium phase at the average level. During the final stage/5 of the experiment the state of conditioned reflex activity once more improved, but did not reach the level of the ground control. The data obtained indicate that during an 18.5 day space flight there is only a partial adaptation on the part of the functions of the higher portions of the central nervous system in animals; the adaptation occurs in waves and, for the most part, affects the stimulation process, whereas the inhibitory process shows no adaptation during an experiment of this length.

The general condition of the animals following flight was completely satisfactory. Average weight gain during flight was 46.6 g and was pretty well the same for individual animals; rats in the synchronous control gained 54 g and those in the vivarium control 59 g. Table I gives results of pathologicoanatomical dissection as well as individual body and organ weights for each animal in the flight, synchronous and vivarium groups.

An analysis of the blood sampled after flight hours 7-8 revealed that the experimental group showed a tendency to increase concentration of leucocytes, neutrophils and lymphopenia, which agrees with results obtained previously and makes it possible to speak of the development of stress reaction in animals of the flight

group by the time of examination. Against this background we developed an additional stress test (2.5 hr "fixation stress") which was accompanied by the same reaction (in respect to direction of change) on the part of the cellular elements in the blood as that noted in the control groups: neutrophilosis, reduced percentage of lymphocytes and reduced lymphocyte/neutrophil ratio; however, the seriousness of the changes in the experimental and control animals was not the same. Prior to the stress test the lymphocyte/neutrophil ratio was 0.58 in the flight group and in the vivarium and synchronous controls 2.6 and 1.82; at the end of the test conducted following /6 hours 7-11 after flight it was 0.2, 0.47 and 0.42 (respectively), and after completion of the test 0.1, 0.24 and 0.21. Thus, animals subjected to the effect of a complex of factors of space flight in the experiments on the biosatellite retained their capability of adequate reaction by cellular elements of the blood system to an added stress effect despite the fact that the initial blood picture (postflight and pretest) of the animals in the experimental group differed significantly from that in the control.

Table II presents data on lipid content in the plasma and tissues and Table III provides information on the activity of some enzymes in the mitochondria and cytoplasm of the cells of the liver in animals in the "stress" experiment. the final conclusion on the "stress" experiment will be drawn on the basis of the results of biochemical analysis of the blood and endocrine glands, and also cytological examinations of the bone marrow and lymph organs in animals studied on day 6 following flight after a series of 5 stress tests.

Along with the study of stress reaction mechanisms that developed in animals during flight and after return to Earth, other studies were carried out on the biosatellite Kosmos-1129 that were specific and associated with the effect of weightlessness and of changes in the support-motor apparatus. Metabolism was studied. First of all a study was made of the body composition of the animals and its regular changes revealed as associated with the effect of space flight factors (Tables IV, Va, Vb, Vc).

In the "biorhythm" experiment we studied the condition of circulation rhythm and the rate of its phasic restructuring when there was an inversion of the light regime under conditions of space flight. Animals during flight presented normal periods for the formation of circulation rhythm and this was stable. During the

readaptation period in flight animals and in the synchronous group signs of desynchronosis were noted. Toward the end of the observations (25 days after the experiment) normalization set in for animals of the synchronous control group, whereas in the flight group no recovery occurred during that period. /7

In the "ontogenesis" experiment males and females of the flight group were mated with each other and with intact animals at various periods following return to Earth. The resulting progeny was studied both during the first postnatal days and at separate intervals (up to 3 months) by the use of functional tests (fixation stress). We propose to continue our observations of animals that were on the biosatellite until the time of their natural demise, assessing age-related resistance changes, reproductive ability and vitality in the progeny. Tables VI and VII present some characteristics of animals in the "ontogenesis" experiment.

II. Biological Research /25

1. Study of the Physiological Condition of Tumorous Carrot Tissue Induced by *Agrobacterium tumefaciens* (results of research carried out by Soviet specialists with the concurring Soviet-American experiment K-301)[1]

The work is a study of the condition of material, accumulation of dry mass, tissue respiration activity and permeability of cellular membranes to tumorous carrot tissue.

Tissue respiration activity was determined by the polarographic method. Membrane permeability was assessed on the basis of change in specific electric conduction of tissue extracts. Ion concentration in the tissue extract was determined by flame photometry.

Condition of Material

The condition of material was described immediately upon opening of containers and documented with photographs.

TABLE I

BODY WEIGHT AND WEIGHT OF SOME INTERNAL ORGANS OF ANIMALS OF FLIGHT, SYNCHRONOUS AND VIVARIUM GROUPS

No. of animals	When sacr. [Oct]	Body weight		Weight of organs						Dissection results
		Before exp.	Time sacr.	Liver[1]	Kidn.[2]	Myocard.[1]	Thymus[3]	Spleen[3]	Adren.[1]	
I	2	3	4	5	6	7	8	9	IO	11
I ♂	I4.IO.	288	335	I4,IO	2,3[illegible]	0,[illegible]	263	768	56	Hydronephrosis (rt); subpleural miliary nodules in lungs
2 ♂	"	288	335	I2,83	[illegible]	0,[illegible]	I74	650	33	Subpleural miliary nodules in lungs
3 ♂	"	286	3[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Hydronephrosis (left)
4 ♂	"	288	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Hydronephrosis (lf); small wrinkled spleen with deformed cicatrix; atrophied testes
5 ♂	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible] ♂	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fresh rupture in epiphysis of left pelvic bone
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Hydronephrosis (rt)

[Note: In all Tables and Figures read Roman I as Arabic 1 and commas as decimal points]

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5V	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Subpleural miliar nodules in lungs
6V	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	55	
7V	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	58	As above
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	62	
1S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	46	
2S	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	47	
3S	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Hydronephrosis (right)
4S	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Hypertrophy of spleen, purulent inflammation of left testicle
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
6S	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Small gray subpleural nodules in lungs
[illegible]	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Hydronephrosis (left), miliary nodules in lungs
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Hydronephrosis (left)
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Miliary nodules in lungs

I	2	3	4	5	6	7	8	9	I0	1
I2 ♂		286	344	I0,87	2,70	0,904	I95	7 3[illegible]	56	Hydroneph. (lf); rupture of left pelvic bone (with dev. of bone callous)
I3♂		3I6	384	II,75	3,70	0,896	240	750	53	
M		29I	353	II,69	2,86	0,908	206	7I7	56	
I4 ♂		276	326	8,37	2,00	0,9I6	I2I	395	3I*	Hydronephrosis (left) in one kidney
I5 ♂		298	342	I0,07	2,57	0,9I0	90	520	60	
I6 ♂		294	322	8,95	2,I[illegible]	0,984	I34	6[illegible]	6I	
I7 ♂		278	3II	8,4[illegible]	2,I6	0,9[illegible]	I76	475	6[illegible]	Hydronephrosis (right)
I8 ♂		286	3[illegible]	8,82	2,[illegible]	0,9[illegible]	I9[illegible]	56[illegible]	63	Hydronephrosis (right); miliary nodules in lungs
I9 ♂		296	3I5	I0,[illegible]	4,[illegible]	I,07[illegible]	[illegible]	588	7I	Hydronephrosis (left); hypertrophy of left card. ventricle
20 ♂		306	372	I4,[illegible]	2,72	0,I8[illegible]	[illegible]	48[illegible]	56	
M		29I	326	9,[illegible]	2,[illegible]	0,78[illegible]	I9[illegible]	5[illegible]5	63	
[illegible]V	[illegible]	[illegible]	3[illegible]	I2,[illegible]	[illegible]	[illegible]	2[illegible]	7[illegible]	4[illegible]	
[illegible]V		[illegible]	[illegible]	I[illegible],[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Miliary nodules in lungs
[illegible]V		[illegible]	[illegible]	I[illegible],[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4I	
[illegible]V		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	As above
[illegible]V		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	As above

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1	2	3	4	5	6	7				
M		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
I4 V		[illegible]	[illegible]	[illegible]	2,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
I5 V		[illegible]	347	I[illegible],75	2,[illegible]	I,[illegible]	[illegible]	[illegible]	[illegible]	Hydronephrosis (lf); miliary nodules in lungs
I6 V		274	357	II,[illegible]	2,[illegible]	I,[illegible]	[illegible]	[illegible]	[illegible]	Miliary nodules in lungs
I7 V		278	345	I0,75	2,44	I,[illegible]	I73	[illegible]	83	
I8 V		294	384	II,42	3,70	I,055	I5I	6I5	60	
I9 V		278	350	I2,[illegible]	2,26	I,[illegible]	247	715	50	
20 V		3I[illegible]	3[illegible]	I3,[illegible]	3,60	I,[illegible]	[illegible]	[illegible]	54	
M		265	355	II,[illegible]	2,69	I,[illegible]	[illegible]	704	59	
8 S	25.I0.	[illegible]	[illegible]	I0,35	2,39	0,[illegible]	33[illegible]	[illegible]	47	As above
9 S		3I2	[illegible]	I3,67	2,50	0,[illegible]	33[illegible]	[illegible]	46	
I0 S		3II	374	II,[illegible]	2,3[illegible]	0,[illegible]	[illegible]	[illegible]	[illegible]	
II S		280	366	I2,30	2,29	0,[illegible]	3[illegible]	[illegible]	[illegible]	As above
I2 S		294	344	I0,62	2,28	0,883	33[illegible]	675	46	As above
I3 S		33[illegible]	4[illegible]	I3,6[illegible]	2,69	I,047	454	9[illegible]	45	
M		304	373	I2,07	2,4I	0,950	337	756	5I	
I4 S		3[illegible]	33[illegible]	[illegible]	2,[illegible]	0,[illegible]	[illegible]	[illegible]	57	Hydronephrosis (left)

S		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Miliary nodules in lungs
[illegible]		288	332	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]S		286	333	[illegible]	[illegible]	[illegible]	I74	[illegible]	
I8S		284	324	8,57	[illegible],64	0,9I5	I35	[illegible]	
[illegible]S		3I9	360	I0,47	2,30	0,985	I29	[illegible]	
20S		308	330	8,85	2,28	[illegible]	[illegible]	[illegible]	
M		299	337	9,33	2,08	[illegible]	I59	[illegible]	
[illegible]	I2.II.	320	400	I0,[illegible]	2,50	–	[illegible]	[illegible]	Miliary nodules in lungs; deformed sternum
[illegible]		306	[illegible]	9,05	[illegible]	–	[illegible]	[illegible]	
23J		290	350	9,56	[illegible]	–	[illegible]	[illegible]	Miliary nodules in lungs
24J		344	410	[illegible]	[illegible]	–	[illegible]	[illegible]	As above
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	As above; rupture of right hip with bone callous
		[illegible]	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	–			
[illegible]			[illegible]	[illegible]	[illegible]	–			Miliary nodules in lungs
				[illegible]	[illegible]	–			

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I	2	3	4	5	6	7				
24 S		[illegible]	[illegible]	[illegible]	[illegible]	–				
25 S		354	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	
M		334	447	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	
24 V		290	365	[illegible]	[illegible]	–	[illegible]	[illegible]	54	Miliary nodules in lungs
25 V		330	430	[illegible]	[illegible]	–	[illegible]	[illegible]	55	As above
38 V		328	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	[illegible]	As above
39 V		305	375	9,44	[illegible]	–	[illegible]	[illegible]	[illegible]	
42 V		275	345	[illegible]	[illegible]	–	270	609	53	Hydronephrosis (right); miliary nodules in lungs
		306	[illegible]	[illegible]	[illegible]	–	[illegible]	[illegible]	59	

Remarks: 1. Weight "before experiment" given for animals of flight group and vivarium control on 22 Sept and for the synchronous control on 30 Sept.

2. Tables make use of data of R. A. Tigranyan (1), N. A. Ilyushko (2), L. V. Serova (3), A. S. Pankova (4), L. V. Serva and R. A. Tigranyan (5).

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TABLE II

LIPID CONTENT IN PLASMA AND TISSUES (DATA OF I. ALERS AND R. A. TIGRANYAN)

Index being studied	PLASMA				Adipose tissue	
					White	Brown
Group	Phospholipids mM/liter	Total cholesterol mM/liter	Triglycerides mM/liter	Unesterized fatty acids uM/liter	Unesterized fatty acids uM/liter	
V_1	I,59±0,04	I,48±0,II	0,78±0,06	49I±68	6,2I±[illegible],0I	I0,7±0,9
F_1	2,68±0,I0	2,25±0,04	I,20±0,20	623±56	5,36±0,99	I7,4±I,3
S_1	2,I9±0,03	2,I3±0,2I	I,26±0,I2	5I6±36	5,64±0,36	I4,8±0,9
V_2	I,96±0,I6	2,30±0,II	I,20±0,I2	833±60	5,[illegible]±0,3I	I4,5±0,6
F_2	I,75±0,I6	2,I8±0,I3	0,74±0,07	697±32	4,[illegible]±0,42	I6,6±I,I
S_2	I,57±0,II	2,2I±0,I2	I,83±0,[illegible]	893±36	4,[illegible]±0,[illegible]	I[illegible],[illegible]±I,[illegible]
V_3	I,66±0,II	2,09±0,I6	I,23±0,[illegible]3	9I6±33	7,[illegible]±[illegible],77	[illegible]
F_3	I,84±0,I9	2,38±0,I4	I,84±0,[illegible]	I242±II4	9,[illegible]±[illegible],79	I[illegible]
S_3	I,77±0,I3	2,74±0,I6	0,97±0,I[illegible]	903±89	6,[illegible]±0,5[illegible]	[illegible]
analysis variance +=P < 0,05 ++=P < 0,[illegible]	$F_1 : V_1$ ++ $F_1 : S_1$ ++ $F_1 : F_2$ ++ $V_1 : S_1$ ++ $V_2 : S_2$ + $S_1 : S_2$ ++	$F_1 : V_1$ ++ $V_1 : S_1$ ++ $S_2 : S_3$ + $V_3 : S_3$ ++	$F_2 : V_2$ + $F_2 : S_2$ ++ $F_3 : V_3$ ++ $F_3 : S_3$ ++ $F_2 : F_3$ ++ $S_1 : S_2$ ++	$F_3 : V_3$ ++ $F_3 : S_3$ ++ $S_1 : S_2$ ++ $F_2 : F_3$ ++	$F_3 : V_3$ + $F_3 : S_3$ ++ $F_2 : F_3$ ++	$F_3 : V_3$ + $F_3 : S_3$ ++ $F_2 : F_3$ + $F_1 : V_1$ ++ $V_1 : S_1$ ++

F = flight V = vivarium control S = synchronous control 1, 2, 3 = number of group

Bottom of column 1 = variation analysis

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TABLE II (continued)

Index	Liver				Bone marrow		Thymus	
Group	Unesterized fatty acids	Phospholipids	Cholesterol	Triglycerides uM/gram	Phospholip.	Triglycer.	Phosphol.	Triglycer.
V_1	3,69±0,43	I8,0±I,I	I3,4±0,50	23,6±2,2	I5,4±I,5	I8,2±6,6	2I,I±0,6	I7,7±4,7
F_1	5,57±0,32	I7,2±I,I	I3,2±0,73	30,0±2,5	I4,0±0,5	5I,8±7,0	23,I±0,9	54,0±I6,6
S_1	2,52 ±0,4I	I5,8±0,5	II,3±0,28	2I,9±2,4	I5,3±I,0	I6,5±5,5	22,2±0,9	26,3±6,3
V_2	3,30±0,40	I6,5±0,7	I0,2±0,64	I9,7±2,[illegible]	I3,I±2,3	I3,4±2,5	I9,4±I,0	I3,[illegible]±I,5
F_2	5,82±0,39	I7,6±0,7	II,9±0,99	22,0±2,0	I0,4±I,[illegible]	42,4±[illegible]	I7,3±I,2	I5,2±I,5
S_2	7,85±0,4I	I6,3±I,I	I0,9±0,[illegible]	I7,9±I,I	I2,8±I,3	34,6±4,5	I7,[illegible]±0,7	9,7±0,7
V_3	5,I0±0,39	I7,9±0,6	I3,3±0,[illegible]	23,[illegible]	I0,6±I,7	29,3±4,[illegible]	[illegible]	[illegible]
F_3	8,94±0,40	I9,0±0,7	I4,2±I,I9	3I,4±2,7	I0,[illegible]±I,[illegible]	67,I±I9,[illegible]	I6,6±I,[illegible]	[illegible]
S_3	II,07±0,73	I6,9±0,6	I3,[illegible]±0,9[illegible]	3I,[illegible]±[illegible],3	II,7±[illegible]	23,4±3,[illegible]	[illegible]	[illegible]
анализ вариации +=p < [illegible] ++=p < [illegible]	$F_1 : V_1$ ++ $F_1 : S_1$ ++ $F_2 : S_2$ ++ $F_2 : V_2$ ++ $V_2 : S_2$ ++		$V_2 : V_3$ + $S_2 : S_3$ +	$F_1 : S_1$ + $S_2 : S_3$ ++ $F_2 : F_3$ +	$F_1 : F_2$ ++ $F_3 : V_3$ ++ $S_1 : S_2$ +	$F_1 : V_1$ ++ $F_1 : S_1$ ++ $F_2 : V_2$ ++ $F_3 : V_3$ ++ $F_3 : S_3$ ++		$F_1 : V_1$ ++ $F_1 : S_1$ ++ $F_1 : F_2$ ++
Variation analysis	$V_2 : S_3$ ++ $S_2 : S_3$ ++ $F_3 : V_3$ ++ $F_3 : S_3$ ++ $V_3 : S_3$ ++ $F_2 : F_3$ ++ $S_1 : S_2$ ++							

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TABLE III

ACTIVITY OF SOME ENZYMES IN MITOCHONDRIA AND CYTOPLASM OF LIVER CELLS (DATA OF Ye. A. VETROVA, R. A. TIGRANYAN)

Index	Mitochondria		Cytoplasm		
Group	Malate dehydrogenase mM nitrogenation	Isocitrate dehydrogenase mM phosphorylation	Malate dehydrogenase mM nitrogenation	Isocitrate dehydrogenase mM phosphorylation	Lactate dehydrogenase mM nitrogenation
V_1	3,89±0,31	0,22±0,04	3,74±0,21	0,31±0,[illegible]	13,56±0,4[illegible]
$Ж_1$	2,94±0,23	0,12±0,01	3,64±0,15	0,35±0,[illegible]3	13,39±0,[illegible]5
S_1	3,21±0,27	0,12±0,01	3,55±0,44	0,30±0,[illegible]	10,30±0,01
V_2	4,04±0,10	0,22±0,05	3,69±0,25	0,29±0,[illegible]	13,[illegible]5±0,[illegible]5
$Ж_2$	3,84±0,27	0,27±0,04	3,30±0,21	0,33±0,[illegible]	[illegible]
S_2	3,95±0,65	0,28±0,05	3,73±0,40	0,31±0,[illegible]	[illegible]
V_3	3,84±0,12	0,20±0,04	3,78±0,27	0,31±0,[illegible]	13,[illegible]
$Ж_3$	3,40±0,38	0,28±0,04	3,44±0,37	0,33±0,[illegible]	[illegible]
S_3	3,23±0,51	0,26±0,[illegible]	3,12±0,04	0,31±0,[illegible]	[illegible]
V_4	4,38±0,45	0,[illegible]	[illegible]	0,[illegible]	[illegible]
$Ж_4$	3,[illegible]±0,43	0,25±0,[illegible]	3,[illegible]±0,3[illegible]	0,[illegible]	[illegible]
S_4	3,06±0,3[illegible]	0,2[illegible]	3,[illegible]	0,3[illegible]	[illegible]
Anemia [illegible]	$Ж_1 : V_1$ +	$Ж_1 : V_1$ +		$S_1 : V_1$ + +	
++=P< 0,[illegible]	$Ж_1 : Ж_2$ +	$Ж_1 : Ж_2$ +		$Ж_2 : V_2$ +	
+++=P< 0,[illegible]		$S_1 : V_1$ +		$S_2 : V_2$ + + +	
+++=P< 0,01		$S_1 : Ж_2$ +		$Ж_3 : V_3$ + + +	
				$S_3 : V_3$ + + +	
				$S_4 : V_4$ + + +	

TABLE IVa. BODY AND ORGAN WEIGHT OF ANIMALS IN GRAMS /17

	Flight group			Vivarium group			P
	M		m	M		m	
Live weight before experiment	3I4,0	±	[illegible],67	3I0,2	±	3,[illegible]	
Live weight after experiment	357,2	±	4,I3	37I,2	±	5,3[illegible]	
Total body mass	349,06	±	5,9I	348,84	±	5,58	
Pure body mass	33I,38	±	4,5I	336,23	±	5,63	
Skin	52,95	±	I,I9	58,2I	±	I,I3	< 0,02
Carcass + tail	I82,64	±	4,09	I94,98	±	3,57	
Internal organs + blood	95,80	±	I,93	83,04	±	I,92	< 0,002
Abdominal fat	I4,45	±	0,86	7,90	±	I,I8	< 0,0I
Blood	23,20	±	0,32	23,54	±	0,39	
Gastrointestinal tract	I6,02	±	0,42	I3,48	±	[illegible]	< 0,0[illegible]
Liver	I9,03	±	0,[illegible]	I5,[illegible]3	±	0,[illegible]	< 0,0[illegible]
Sex organs	I2,0I	±	0,02	II,78	±	0,[illegible]	
Lungs and trachea	I,94	±	0,06	I,98	±	0,I4	
Cervical glands	2,I7	±	0,I3	I,72	±	0,06	< 0,02
Kidneys	2,94	±	0,07	2,46	±	0,[illegible]	< 0,0I
Heart	I,23	±	0,06	I,25	±	0,0[illegible]	
Brain	I,99	±	0,02	2,05	±	0,[illegible]	
Spleen	0,57	±	0,02	0,7[illegible]	±	0,06	
Urinary bladder	0,I5	±	0,0I	0,I5	±	0,0[illegible]	
Adrenals	0,II	±	0,005	0,I0	±	0,0[illegible]	
Pelt	7,94	±	0,46	6,86	±	0,[illegible]	
Intestinal content	9,74	±	I,46	6,84	±	[illegible]	

TABLE IVb. BODY AND ORGAN WEIGHT OF ANIMALS IN GRAMS

/18

	Flight group			Synchronous group			P
	M		m	M		m	
Live weight before experiment	3I4,0	±	I,67	3I0,[illegible]	±	2,40	
Live weight after experiment	357,[illegible]	±	4,I3	373,0	±	2,I4	< 0,0I
Total body mass	349,06	±	5,9I	358,96	±	2,80	
Pure body mass	33I,38	±	4,5I	344,08	±	I,6[illegible]	< 0,05
Skin	52,95	±	I,I9	60,I4	±	I,25	< 0,0I
Carcass + tail	I82,64	±	4,09	I89,9I	±	0,59	
Internal organs + blood	95,80	±	I,93	94,62	±	I,72	
Abdominal fat	I4,45	±	0,86	I4,I6	±	I,42	
Blood	23,20	±	0,32	24,I3	±	0,II	< 0,05
Gastrointestinal tract	I6,02	±	0,42	I5,64	±	0,27	
Liver	I9,03	±	0,84	I7,I3	±	0,5[illegible]	
Sex organs	I2,0I	±	0,69	I2,85	±	0,[illegible]7	
Lungs and trachea	I,94	±	0,06	I,87	±	0,06	
Cervical glands	2,I7	±	0,I3	I,3[illegible]	±	0,04	
Kidneys	2,94	±	0,07	2,72	±	0,06	< 0,0[illegible]
Heart	I,23	±	0,06	I,34	±	0,05	
Brain	I,99	±	0,02	I,95	±	0,05	
Spleen	0,57	±	0,02	0,66	±	0,0[illegible]	< 0,0[illegible]
Urinary bladder	0,I5	±	0,0[illegible]	0,I7	±	0,0[illegible]	
Adrenals	0,II	±	0,005	0,I2	±	0,00[illegible]	
Pelt	7,94	±	0,46	6,9I	±	0,5[illegible]	
Intestinal content	9,74	±	I,48	7,27	±	I,32	

TABLE IVc. BODY AND ORGAN WEIGHT OF ANIMALS IN GRAMS /19

	Synchronous group			Vivarium group			P
	M		m	M		m	
Live weight before experiment	310,3	±	[illegible]	[illegible]	±	[illegible]	
Live weight after experiment	324,0	±	[illegible]	[illegible]	±	[illegible]	
Total body mass	352,[illegible]	±	[illegible]	[illegible]	±	[illegible]	
Pure body mass	344,[illegible]	±	[illegible]	356,[illegible]	±	[illegible]	
Skin	60,[illegible]	±	[illegible]	58,[illegible]	±	1,13	
Carcass + tail	189,91	±	0,59	[illegible]	±	[illegible]	
Internal organs and blood	94,62	±	1,72	83,[illegible]	±	[illegible]	< [illegible]
Abdominal fat	14,16	±	1,42	7,90	±	[illegible]	< [illegible]
Blood	24,13	±	0,11	23,54	±	[illegible]	
Gastrointestinal tract	15,64	±	0,27	13,46	±	0,57	< 0,01
Liver	17,13	±	0,54	15,33	±	[illegible]	
Sex organs	12,85	±	0,27	11,78	±	[illegible]	< 0,02
Lungs and trachea	1,87	±	0,06	1,98	±	0,14	
Cervical glands	1,99	±	0,04	1,72	±	[illegible]	< 0,01
Kidneys	2,72	±	0,06	2,46	±	[illegible]	
Heart	1,24	±	0,05	1,25	±	[illegible]	
Brain	1,95	±	0,05	2,03	±	0,04	
Spleen	0,66	±	0,02	0,71	±	0,06	
Urinary bladder	0,17	±	0,015	0,15	±	0,01	
Adrenals	0,12	±	0,005	0,10	±	0,01	
Pelt	6,91	±	0,18	6,86	±	0,27	
Intestinal content	7,27	±	1,88	6,84	±	1,36	

TABLE Va. COMPOSITION OF ANIMAL BODY COMPONENTS

	Flight group			Vivarium group			P
	M		m	M		m	
Skin							
Wet mass in g	59,[illegible]	±	[illegible]	[illegible]	±	[illegible]	[illegible]
Dry mass in g	27,30	±	[illegible]	24,45	±	[illegible]	
Water content in g	35,65	±	0,49	33,77	±	[illegible]	< [illegible]
Dry degreased mass in g	12,[illegible]	±	0,31	15,[illegible]	±	[illegible]	< [illegible]
Fat content in g	14,36	±	1,49	[illegible]	±	[illegible]	< [illegible]
Lean mass in g	38,59	±	0,75	48,93	±	[illegible]	< [illegible]
Internal organs + blood							
Wet mass in g	95,80	±	1,92	83,04	±	[illegible]	< [illegible]
Dry mass in g	37,66	±	1,11	34,10	±	[illegible]	< [illegible]
Water content in g	58,14	±	1,45	58,94	±	0,35	
Dry degreased mass in g	11,95	±	0,23	11,29	±	[illegible]	< [illegible]
Fat content in g	25,71	±	1,09	12,81	±	[illegible]	< [illegible]
Lean mass in g	70,09	±	1,67	70,23	±	0,37	
Carcass + tail							
Wet mass in g	182,64	±	4,10	194,98	±	3,37	
Dry mass in g	70,89	±	2,55	65,59	±	1,55	
Water content in g	111,75	±	2,85	129,39	±	2,30	< 0,002
Dry degreased mass in g	51,22	±	1,23	56,24	±	1,24	< 0,05
Fat content in g	19,67	±	0,63	9,36	±	1,34	< 0,001
Lean mass in g	162,97	±	4,05	185,62	±	3,51	< 0,01
Intestinal content							
Wet mass in g	9,74	±	1,48	6,84	±	1,36	
Dry mass in g	2,44	±	0,55	1,25	±	0,13	
Water content in g	7,30	±	0,94	5,80	±	1,32	

TABLE Vb. COMPOSTION OF ANIMAL BODY COMPONENTS /21

	Flight group		Synchronous group		P
	M	m	M	m	
Skin					
Wet mass in g	52,[illegible]	± [illegible]	[illegible]	± [illegible]	< 0,0I
Dry mass in g	27,[illegible]	± I,4[illegible]	[illegible]	± 0,[illegible]	
Water content in g	25,65	± 0,49	30,98	± I,[illegible]	< 0,0I
Dry degreased mass in g	I2,[illegible]	± 0,3I	I4,[illegible]	± 0,5[illegible]	
Fat content in g	I4,36	± I,49	I4,93	± 0,[illegible]	
Lean mass in g	38,59	± 0,75	45,[illegible]I	± I,[illegible]	< 0,0I
Internal organs + blood					
Wet mass in g	95,80	± I,92	94,62	± I,73	
Dry mass in g	37,66	± I,II	35,66	± I,48	
Water content in g	58,I4	± I,45	58,96	± 0,64	
Dry degreased mass in g	II,95	± 0,23	II,97	± 0,II	
Fat content in g	25,7I	± I,09	23,70	± I,4I	
Lean mass in g	70,09	± I,67	70,93	± 0,72	
Carcass + tail					
Wet mass in g	I82,64	± 4,I0	I89,9I	± 0,59	
Dry mass in g	70,89	± 2,55	70,3I	± 0,86	
Water content in g	III,75	± 2,85	II9,60	± I,24	< 0,05
Dry degreased mass in g	5I,22	± I,23	52,6I	± 0,80	
Fat content in g	I9,67	± 0,63	I7,70	± I,63	
Lean mass in g	I62,97	± 4,05	I72,2I	± I,96	
Intestinal content					
Wet mass in g	9,74	± I,48	7,27	± I,88	
Dry mass in g	2,44	± 0,55	I,58	±0,52	
Water content in g	7,30	± 0,94	5,68	± I,37	

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TABLE Vc. COMPOSITION OF ANIMAL BODY COMPONENTS /22

	Synchronous group			Vivarium group			P
	M		m	M		m	
Skin							
Wet mass in g	60,14	±	1,25	58,21	±	1,13	
Dry mass in g	29,16	±	0,40	24,45	±	1,22	< 0,01
Water content in g	30,98	±	1,13	33,77	±	0,81	
Dry degreased mass in g	14,92	±	0,52	15,17	±	0,38	
Fat content in g	14,93	±	0,64	9,28	±	1,45	< 0,01
Lean mass in g	45,21	±	1,65	48,93	±	1,16	
Internal organs + blood							
Wet mass in g	94,62	±	1,73	83,04	±	1,92	< 0,01
Dry mass in g	35,66	±	1,48	24,10	±	1,89	< 0,002
Water content in g	58,96	±	0,64	58,94	±	0,35	
Dry degreased mass in g	11,97	±	0,1[illegible]	[illegible]	±	[illegible]	
Fat content in g	23,70	±	1,[illegible]	[illegible]	±	[illegible]	< [illegible]
Lean mass in g	70,93	±	0,72	[illegible]	±	0,37	
Carcass + tail							
Wet mass in g	189,97	±	0,78	[illegible]	±	[illegible]	
Dry mass in g	76,31	±	0,[illegible]	[illegible]	±	[illegible]	< 0,05
Water content in g	113,00	±	1,[illegible]	[illegible]	±	[illegible]	< [illegible]
Dry degreased mass in g	52,67	±	0,[illegible]	[illegible]	±	[illegible]	< [illegible]
Fat content in g	17,70	±	1,63	[illegible]	±	[illegible]	< [illegible]
Lean mass in g	172,21	±	1,[illegible]	[illegible]	±	[illegible]	< [illegible]
Intestinal content							
Wet mass in g	7,07	±	1,[illegible]	[illegible]	±	[illegible]	
Dry mass in g	1,56	±	0,52	[illegible]	±	[illegible]	
Water content in g	5,68	±	1,37	[illegible]	±	[illegible]	

TABLE VI

NUMBER AND SOME CHARACTERISTICS OF NEONATE RATS IN ONTOGENESIS CONTROLS

Group / Index	Flight	Synchronous experiment	Vivarium control	Life support system	Vivarium control life support system
Number ♀	5	5	6	6	6
Parturient number ♀	–	–	6	4	5
Average number of rats in flight	–	–	10,3±1,1	10,5±1,6	[illegible]
Mean flight ratio ♀ / ♂	–	–	4/6	4,5/5,5	[illegible]
Average ratling weight at birth	–	–	6,38±0,[illegible]	6,[illegible]	[illegible]

/23

DYNAMICS OF RAT WEIGHT IN THE "ONTOGENESIS" EXPERIMENT

Animal Number	Date 4.09 (4 Sept. etc.)	II.09	I8.09	22.09	25.09	30.09	I4.I0 (14 Oct. etc.)	I6.I0	I9.I0	22.I0	24.I0	26.I0
F 7	256	268	289	284	–	–	338	346	–	344	350	35I
F II	238	249	257	256	–	–	308	296	–	300	298	303
F 20	234	240	260	254	–	–	268	264	–	276	290	288
F 22	248	248	258	256	–	–	292	280	–	285	290	29I
F 23	252	244	273	258	–	–	300	302	–	320	323	326
S I	258	276	275	–	290	274	–	–	350	360	352	358
S 3	254	265	275	–	280	276	–	–	360	35I	348	359
S 4	256	264	268	–	290	268	–	–	320	3I2	3I0	307
S 5	26I	268	26I	–	276	262	–	–	320	324	323	334
S 6	300	295	305	–	3I2	294	–	–	336	35I	348	352
V I3	240	245	–	–	264	248	–	–	–	330	360	380
V I5	248	253	264	–	275	262	–	–	–	332	334	346
V 25	264	267	275	–	286	27I	–	–	–	370	385	360
V 26	272	268	304	–	302	285	–	–	–	380	387	395
V 28	268	270	286	–	290	268	–	–	–	375	393	4I2

F – flight group

V – vivarium group

S – synchro

FOLDOUT FRAME

TOGENESIS" EXPERIMENT

TABLE VII.

I4.ID	I6.IO	I9.IO	22.IO	24.IO	26.IO	28.IO	29.IO	3I.IO	I.II	2.II	5.II
14 Oct. etc.									1 Nov. etc.		
338	346	-	344	350	35I	348	356	357			
308	296	-	300	298	303	300	306	294			
268	264	-	276	290	288	294	296	3II			
292	280	-	285	290	29I	300	296	308			
300	302	-	320	323	326	326	336	322			
-	-	350	360	352	358	350	348	337			
-	-	360	35I	348	359	352	352	366			
-	-	320	3I2	3I0	307	3I2	3I3	3I6			
-	-	320	324	323	334	326	337	343			
-	-	336	35I	348	352	346	350	336			
-	-	-	330	360	380	394	30I		29.IO		parturition
-	-	-	332	334	346	350	-	parturition -	40I	395 320	2.II
-	-	-	370	385	360	380	400	443	352	parturition	I.II
-	-	-	380	387	395	400	-	442	450	460 38[illegible]	parturition 3.II
-	-	-	375	393	4I2	334	parturition	28.IO			

S -

varium group

synchronous group, control

FOLDOUT FRAME 2

Flight Variant

Tumor growth was uneven and clearly better on dishes A and B. In the case of dishes 33B, 33D and 33C each disc was contaminated by a nonidentified bacterial stimulant. 142 mg of gallic tissue was collected.

Transport Control

Growth of tumor tissue was better when compared with the space variant. There was clear bacterial decomposition on 2 discs in dish B. In dishes A and D growth was relatively more active. Altogether 292.5 mg of gallic tissue was collected.

Abiogenic Control

The growth of gallic tissue in this variant was very insignificant. We noted putrefactive decomposition of discs in dishes C. and D. 55.6 mg /26
of gallic tissue was collected.

Clinostat 90°

Strong bacterial putrefaction was noted in all dishes. Tumor growth was better in dishes A and D. Severe desiccation of discs was noted. In connection with the poor condition of material this variant was not analyzed.

Clinostat 180°

Tumor growth was uneven and better in dishes A and D but here desiccation was noted. Partial decay of discs was noted on dish B. 156 mg of gallic tissue was collected.

Object Mockup

We notice good growth of tumorous tissue in all dishes. There is no contamination. In all 584 mg of gallic tissue was collected.

In our opinion the preferential growth of gallic tissue on dishes A and D is connected with better aeration conditions within the container.

On the basis of a previously planned program it was suggested that the following study be carried out: study of tissue respiration activity, study of cellular membrane peremeability, analysis of membrane lipid compostion, determination of the concentration of endogenous growth regulators in tumorous tissue. In connection with the restricted growth and unsatisfactory condition of the material obtained we found in necessary to curtail the study program. We carried out a determination of tissue respiration activity and membrane peremeability of cells for ions and electrolytes. The material collected was likewise analyzed for dry mass content.

Determination results are presented in Table VIII.

TABLE VIII. DRY MASS OF TUMOROUS TISSUE (IN MG) /27

Variant	Dry mass in mg from 1 g fresh weight
Flight variant	109,06
Transport control	97,96
Abiogenic control	92,47
Clinostat 90°	-
Clinostat 180°	84,75
Object mockup	65,75

There is a slight difference in experiment variants on the basis of dry mass accumulation. The exception is material obtained from the object mockup, where there was less such accumulation.

Determination of Tissue Respiration Intensity

Results of measuring respiratory activity of tumorous tissue are presented in Table IX.

TABLE IX. O_2 ABSORPTION BY CARROT GALLIC TISSUE

Variant	μM O_2/g fresh mat.	1 min %	μM O_2/g dry mat.var.	1 min %
Transport control	472.10^{-3}	100	4819.10^{-3}	100
Flight variant	420.10^{-3}	88,98	3851.10^{-3}	79,91
Abiogenic control	426.10^{-3}	90,25	4605.10^{-3}	95,56
Clinostat 90°	–	–	–	–
Clinostat 180°	552.10^{-3}	116,9	6513.10^{-3}	135,15
Object mockup	355.10^{-3}	75,22	5399.10^{-3}	112,04

It is clear that in the calculation both of dry and wet mass, respiratory intensity for tumorous tissue of the flight variant is somewhat lower than that of other variants. /28

Data obtained in this experiment may be profitably compared with the results of an experiment on biosatellite Kosmos-782, where no essential differences were observed in the structure of the mitochondria of tumorous tissue in different variants.

Determination of Cellular Membrane Permeability to Electrolytes

Results of measurements of cellular membrane permeability of gallic tissue are presented in Table X.

On the basis of the results obtained we may conclude that under conditions of weightlessness and partially when it is simulated with the clinostat, migration of the electrolytes from cells increases. Determination of the concentration of K^+ ions and Na^+ ions indicated that in the flight variant of the experiment there was a sharp increase of K^+ ion migration. In the variant with the "horizontal clinostat" K^+ migration was at a level almost twice higher than that of the control variant. /29 Similar regularities appeared in the study of Na^+. The results of these experiments are presented in Table XI.

TABLE X. SPECIFIC ELECTRIC CONDUCTION OF TISSUE EXTRACTS (RELATIVE UNITS)

Variant	Electric conduction	%
Transport control	I,3	I00
Flight variant	7,0	538
Abiogenic control	-	-
Clinostat 90°	-	-
Clinostat 180°	2,4	I85
Object mockup	I,23	I02

TABLE XI. K^+ AND Na^+ ION CONCENTRATION IN EXTRACT OF GALLIC TISSUE

Variant	Concentration of ions in mM per g of fresh substance			
	K^+	%	Na^+	%
Transport control	66,3	I00	55,I	I00
Flight variant	357;6	539	I09,I	I98
Abiogenic control	-	-	-	-
Clinostat 90°	-	-	-	-
Cinostat 180°	II3,3	I7I	44,3	80
Object mockup	85,7	I29	77,6	I4I

The results obtained in this series of experiments testify to increased permeability of the cell membranes of gallic tissue in respect to ions and electrolytes under conditions of weightlessness. These data are in agreement with results of the experiment on the biosatellite Kosmos-782, where in the flight variant with centrifugation increased cell plasmolyzation was noted.

2. Fowl Embryogenesis Experiment (preliminary results of Soviet specialists' research) /30

The experiment was prepared and carried out in concert with Czechoslovakian specialists. The object of study were the eggs of the Japanese quail (Coturnix coturnix). The apparatus, onboard Incubator-1 was constructed in the CzSSR.

Purpose of the Experiment

A study was made at the early stages of embryonic development of fowl under conditions of weightlessness with a follow-up study of the remote effects of the given factor on adult individuals under laboratory conditions. The material was received in satisfactory condition. At the landing site (14 Oct 1979, 13:00-17:00 hours) an inspection was made of the equipment and biomaterial. The inspection of the equipment revealed that the control system for humidity conditions did not meet technical requirements, i. e. 85% was not maintained in the incubator during flight. Out of 60 eggs kept in the onboard incubator, 40 eggs after landing presented a damaged scorpula, although no content leakage was noted. In most of the eggs embryos at various stages of development were observed.

At the present time one may speak only of the most general results based upon visual control of the conditions of the quail progeny on the day of landing and toward the end of their embryogenetic period (17-18 days after beginning of incubation). Definitive data can be presented only after the completion of a histological and electron microscopic analysis of the embryological material obtained.

During the postflight period no chicks were hatched. The mechanical conditions associated with the completion of the flight of the biosatellite resulted in the destruction of the embryos at whatever point they had at that moment reached in /31 their development. The failure of the air humidifying system in the incubator resulted on day 7 in an abnormal reduction of the relative humidity in the incubator down to 30% (according to data calculations), which explains the increased percentage of dead offspring after this time and the maintenance of the development rate during the second half of the incubation period on the biosatellite as compared with normal development rates. As a result, at the moment when the biosatellite landed

9 embryos had reached the age of IP-12 days (on the development scale for normal conditions), and, if we count the 9 day old embryos, the overall number of developed embryos on the day of landing was 11 or 18% of the total number of eggs in the incubator.

In the synchronous control experiment in the biosatellite mockup incubation day 12 saw 41 live embryos (68%). 19 embryos (32%) had not developed or had died at various stages of development and 8 chicks were hatched.

Fig. 1a, b, c presents the collective data for the experiment.

At the same time, despite the appearance of complicating circumstances of a technical nature that led to the retarded rate of development and increased embryo mortality in the late stages, the presence of 18% developed embryos by the end of the flight makes it possible to answer the basic question of the experiment: is weightlessness the principal obstacle to the smooth flow of embryogenetic processes for quails over a period of 12 days of exposure, which is about 70% of the embryogenesis cycle period for these birds?

It would be good to repeat such an experiment on a biosatellite with a modernized incubator variant.

III. Radiation Dosimetry (preliminary results of research by Soviet specialists with concurrent Soviet-American experiment K-309) /35

In contrast to the previous cooperative experiment K-206, the studies were carried on not only in containers located within the biosatellite but also in external KNA containers for studying minimal protective thickness.

The installations, both on the Soviet and the American side, included the following detectors. In the internal container BB-2M No. 15:

- unit comprising alternating layers of plastic detectors: lexan, cellulose nitrate, CR-39 and an orthogonal unit of the same material (USA);
- units of fissionable foils: ^{237}Np + mica, ^{232}Th + mica, ^{238}U + mica, ^{209}Bi + mica, and thermoluminescent dosimeters ^{6}LiF + cellulose nitrate (with or without cad-

/32

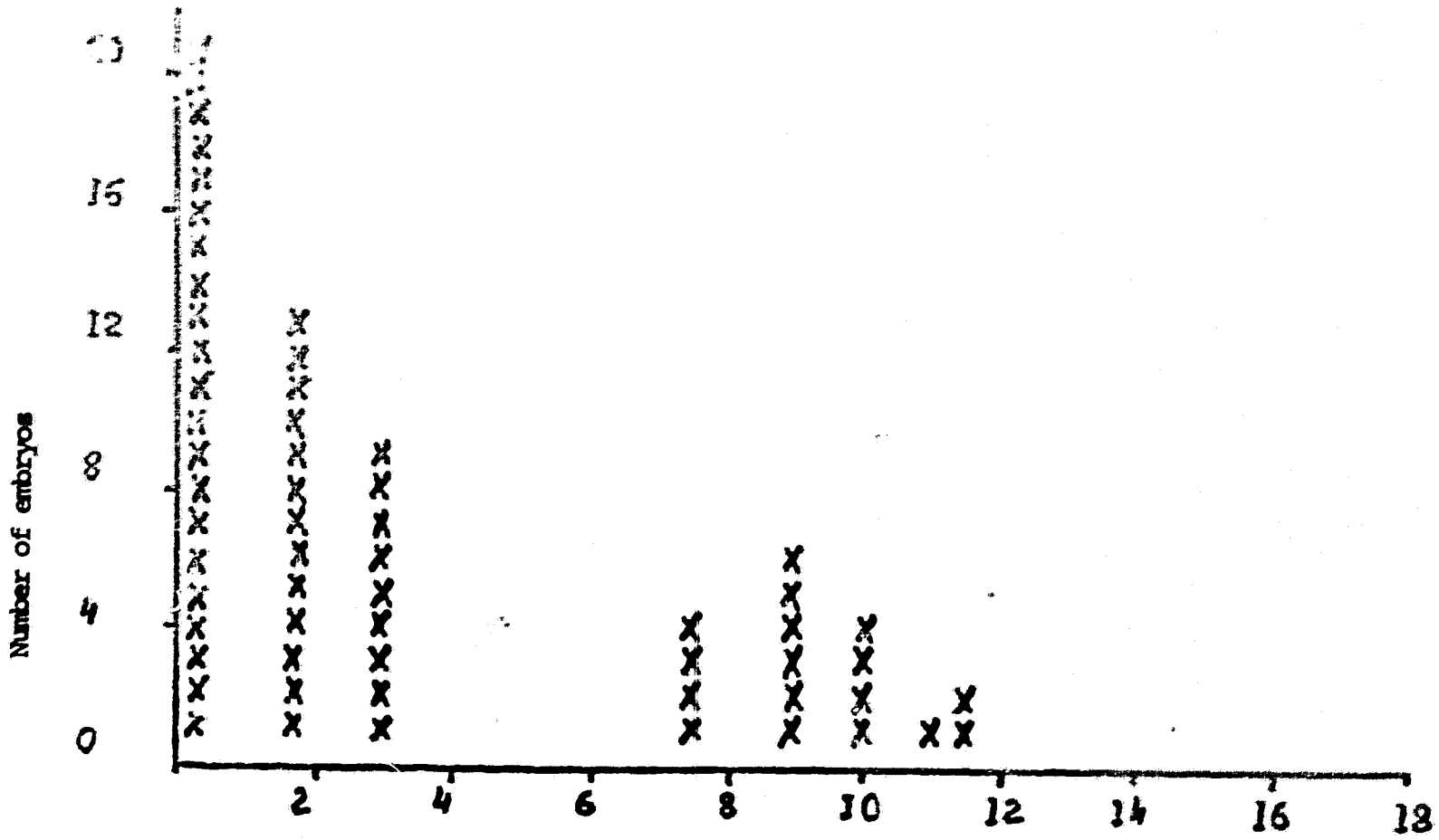

Fig. 1a. Stage of development of embryos in flight experiment.

/33

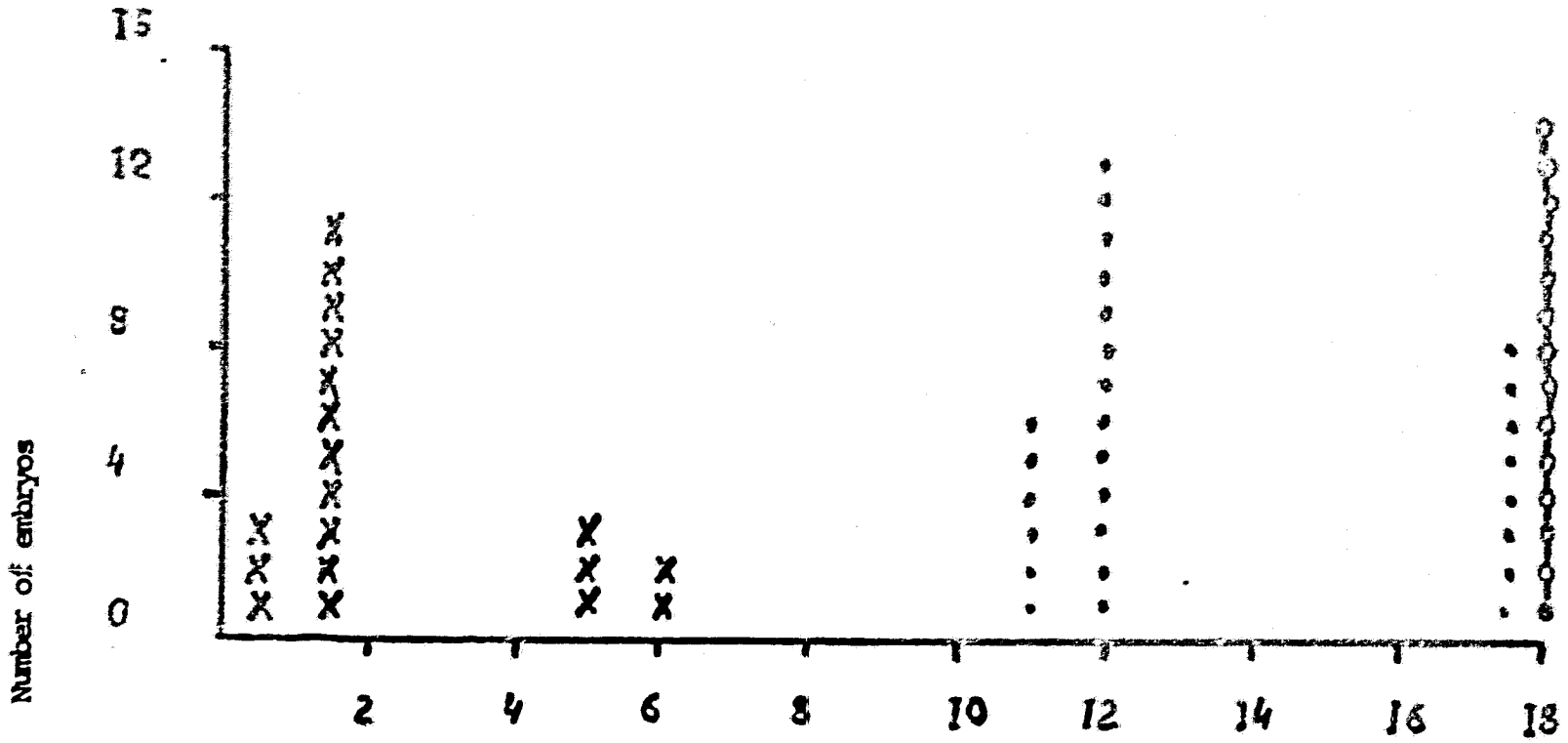

Fig. 1b. Stage of development of embryos in synchronous control.

/34

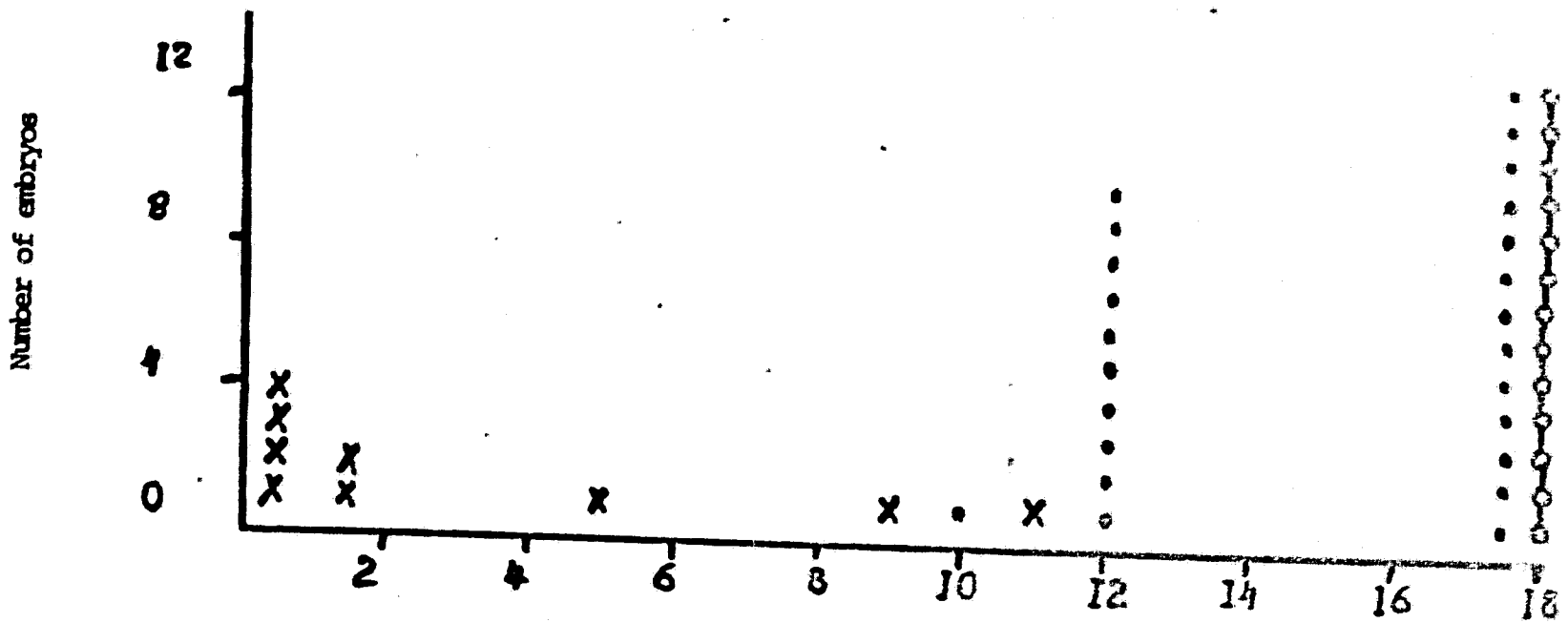

Fig. 1c. Stage of development of embryos in laboratory control.

mium sheathing), ^{7}LiF and CaF (USA);

- unit made of alternating layers of plastic detectors: lexan, cellulose nitrate, CR-39 and orthogonal units of the same material (USSR);
- orthogonal units of nuclear photoemulsion of the BR-2 and Ya-2 types;
- units of fissionable foils ^{209}Bi + glass, ^{238} + glass, ^{237}Np + mica and thermoluminescent glasses of the TLS type.

The external units in KNA containers comprised:

- units of plastic detectors: lexan, cellulose nitrate, CR-39-3 units (USA);
- unit of thermoluminescent dosimeters ^{7}LiF and CaF (USA);
- units of plastic detectors: lexan, cellulose nitrate, CR-39-2 units (USSR); /36
- unit of nuclear emulsion: 12 layers of emulsion type BR-2 and 25 layers of emulsion type Ya-2 (USSR);
- units of fissionable foils ^{238}U + glass, ^{209}Bi + glass, ^{237}Np + mica located on the free spaces of the array (USSR);
- units of thin layers of thermoluminescent dosimeters (110 ÷ 200 microns) - 2 units (Rumania).

The external inspection together with the inspection of the internal content of the containers on being opened showed that in container No. 2 part of the experimental equipment was scorched and rest covered with a film that had formed as the result of thermal destruction of the plastic mass inside the container. In this container were located: 2 units of the USA (plastics and thermoluminescent detectors), 2 units from France (bioblock), 1 unit of the USSR (bioblock), 3 units with dielectric glasses (USSR) and 1 unit with thermoluminescent glass (USSR).

The units from the remaining external containers and from the BB-2M internal containers had not been affected.

At the present time the following work has been done with flight detectors:

- development of nuclear photoemulsion type Ya-2 and BR-2 including development with application of an electric field for removing the background of clearly ionizing radiation;
- chemical treatment of plastic detectors;
- initial measurement of spectra and neutron flow in the nuclear emulsion type Ya-2 from the inner unit;

- measured doses in the thermoluminescent glass from the internal container.

During 1980 measurements will be made of the fluences of charged particles and neutrons in the internal and external units (plastic detectors, nuclear photoemulsions, fissionalbe foils); charge spectra for the heavy nuclei in the external units (plastic detectors). /37

Footnote

1. The figures give the final results obtained by L. V. Voronkov and N. V. Guzhova