THESIS

on

Research Work carried out in the Biochemical

and Physiological Laboratories of the

University of Manitoba

under the direction of Prof. A. T. Cameron

I. The Nature of Chlorine Combination in Urine.

II. The Effects of Inanition upon the Adrenal Bodies and other Organs.

III. The Action of Various Anions on the Frog's Heart and Muscle-Nerve Preparations.

Submitted to the University of Manitoba

for the Master of Arts Degree.

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M. S. Hollenberg.

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I

THE NATURE OF CHLORINE COMBINATION IN URINE

Neuberg[1] states that Berlioz and Lepinois[2], and other French writers found chlorine present in urine partly in organic combination. Later investigators[3,4] denied this. Baumgarten[5] obtained results indicating that 0.04 to 0.2 gm. of organic chlorine is excreted daily in the urine; the maximum found amounted to about 10 per cent of the total chlorine excretion, and was independent of the amount of sodium chloride in the diet and the temperature of the individual. We have been unable to find any more recent work dealing with the possible presence of organic chlorine in urine.

Baumgarten's method consisted in treating urine with sodium nitrite and fuming nitric acid (to reduce chlorates), adding excess of silver nitrate and filtering in darkness, and, after removal of excess silver, concentrating to one-third, again filtering, and heating the filtrate in a retort with concentrated nitric and sulfuric acids free from chloride. The distillate was collected in a dilute silver nitrate solution, and silver chloride was precipitated in this corresponding to the amounts of chlorine indicated above. This chlorine was considered to be in organic combination.

We have repeated Baumgarten's procedure with completely negative results.

Chlorates and perchlorates do not appear to occur normally in urine, and when administered are excreted in the urine unchanged and almost quantitatively within 48 hours.(6) We have confirmed the absence of chlorine-oxy-acids from normal urine by the following procedure.

The halide content of 20 cc. of urine was precipitated as silver chloride in the presence of nitric acid, the precipitate was collected on a Gooch crucible, washed with distilled water, and dried at 100° C. to constant weight. Another 20 cc. of urine was treated with nitrite and fuming nitric acid, allowed to stand for some hours, and then the halide content estimated as just described. The results indicate that chlorine oxy-acids can be considered as absent from normal urine (Table I)

TABLE I

Subject No.	Chloride-chlorine in 100 cc. urine	Chlorine and oxy-acid chlorine in 100 cc. urine
	gm.	gm.
1.	0.7832	0.7837
	0.7837	0.7843
2.	0.6226	0.6233
	0.6220	0.6225
3.	0.5646	0.5649
	0.5650	0.5653

We have made a careful comparison of the chloride (halide) content and the total chlorine (halogen) content of urine. The halide in 20 cc. of urine was estimated as usual. The total halogen was estimated by evaporating 20 cc. of urine with 10 gm. of solid sodium hydroxide, heating the fused mass with additions of very small quantities of potassium nitrate until all organic matter was oxidized, dissolving in water, and estimating the halide as silver chloride as usual. The results are given in Table II.

The slightly greater differences with the pathological urines were probably due to difficultly filterable organized matter, retained in the Gooch crucible but destroyed during fusion. The close agreement indicates the absence of organic chlorine.

TABLE II

Subject No.	Condition	Chloride-chlorine in 100 cc. urine	Total chlorine in 100 cc. urine
1.#	Normal	1.0835 gm.	1.0834
		1.0836	1.0831
		1.0831	1.0834
2.	"	0.6227	0.6235
		0.6216	0.6232
4.	"	0.9383	0.9365
		0.9358	0.9387
5.	"	0.9451	0.9449
		0.9447	0.9444

TABLE II (Cont'd)

Subject No.	Condition	Chloride-chlorine in 100 cc. urine	Total chlorine in 100 cc. urine
6.	Tubercular	0.3034 gm.	0.3028 gm.
		0.3041	0.3037
7.	"	0.4676	0.4867
		0.4880	0.4864
8.	"	0.4480	0.4474
		0.4477	0.4476
9.	"	0.3670	0.3637

A fresh sample

All our figures are for halogens and halides (estimated as chloride). As under normal conditions only traces of bromides and iodides are present in urine, the results can be considered in terms of chlorine and chloride.

We conclude that in the absence of chlorate or similar medication chlorine occurs in urine as chloride only; organic chlorine and chlorine oxy-acids are absent.

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THESIS ON RESEARCH

CARRIED OUT IN THE BIOCHEMICAL AND PHYSIOLOGICAL

LAB ORATORIES OF THE UNIVERSITY OF MANITOBA.

I. The effects of inanition upon the AdrenalBodies and other organs.

II. The effects of different Anions upon Irritability and enzyme Action.

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THE EFFECTS OF INANITION UPON THE ADRENAL BODIES AND OTHER ORGANS.

INTRODUCTION.

This investigation was undertaken as a result of the important discovery made by McCarrison (1) that in pigeons inanition gives rise to a remarkable enlargement of the adrenal glands. He later showed that this hypertrophy also takes place in guinea pigs. I have repeated McCarrison's experiment upon pigeons and have also carried out similar experiments upon rats and dogs and am able to confirm his observations . After a period of inanition there is always a distinct hypertrophy of the adrenal bodies. The results of my experiments further indicate that during the early stages of inanition of rats and dogs there is an increase in the adrenin content whilst during the later stages there is a marked diminution in the adrenin content of these glands.

Although the cardinal object in this investigation was to determine the effect of inanition upon the adrenal bodies I also took the oppertunity to investigate the effect of inanition upon some of the other important organs.

METHOD OF INVESTIGATION AND RESULTS.

The animals were killed by prolonged anaesthesia under chloroform. The different organs were dissected out carefully and immediately transferred to a glass container fitted with a ground glass stopper. The containers and organs were

weighed to the fourth place on a chemical balance and the weight found by difference . The weights of the organs were then calculated as the percentage of the total body weight. I succeeded in confirming fully McCarrison's observations with reference to the adrenals in pigeons. (Tables I.A I.B.) I have also shown that the adrenals of dogs and rats which were subjected to starvation also hypertrophy. (Tables 2A. 2B. 3A. 3B.)

The next part of my investigation was to determine whether it is the cortex or the chromaphil tissue that hypertrophies during inanition. The first method I employed to determine whether or not an increase in chromaphil tissue had occurred was 'the physiological test'.

An adrenal was taken from a normal dog and one from a starved dog. Both were weighed and an extract of each made. Saline solution was then added to each in proportion to its weight. The relative strengths of the two extracts were then compared by intravenous injection of equal quantities into a dog. The corresponding rise of blood pressure indicating the relative strengths of the adrenin content of the glands.

The above 'physiological test' was carried out with the glands of two inanition dogs - one of these was starved for fourteen days and the other for thirty days.

The results of these two tests showed that the animal

which was starved for fourteen days there was a distinct increase in the adrenin content of the gland and thus of the chromaphil tissue. This result is shown in tracig I. where it is evident that the injection of 2cc of the inanition extract produced a greater rise of blood pressure than did 4cc of the normal extract. I fixed and stained the other adrenal with $K_2Cr_2O_7$ and cut serial sections with the freezing microtome and compared them with those of a normal gland. A marked increase in the chromaphil tissue was evident.

In the case of the animal starved for thirty days the 'physiological test' indicated a decrease in the adrenin content of the gland. Injection of 5cc gave a lessern rise than an equal volume of the normal extract (Tracing 2)

Fom the above two tests I concluded that during the early stages of inanition the amount of chromaphil tissue and thus the amount of adrenin have been distinctly increased in the gland whereas in the later stages of inanition a reduction in the adrenin content is apparent.

Since the adrenals as a whole increase in weight and the medulla, which is that part of the gland which contains the adrenin is greatly reduced after prolonged inanition, it is obvious that the cortical tissue must have increased in weight. This conclusion is identical to that obtained by McCarrison (2).

Since all chromaphil tissue is not restricted to the medulla of the adrenal I also investigated the effect of

(This paragraph belongs to page 4 and should be read in place indicated)

The conclusion, that during the early stages of inanition there is an increase in the amount of adrenin in the adrenal bodies and that during the later stages the amount of adrenin is greatly reduced, was further corroborated by a series of actual chemical determinations of the adrenin content, first of normal glands and then of the glands taken from the starved animals - thus showing the actual quantitative increase or decrease of adrenin due to inanition. In these determinations I used the method devised by Folin, Cannon, and Denis (3) for the estimation of adrenin in adrenals.

inanition upon the abdominal chromaphil body of the dog. The method of procedure I adopted in this determination was as follows. Immediately after the animal was killed a swab moistened with a 3.5% solution of $K_2Cr_2O_7$ was left on the chromaphil body for a period of 12 hours. The results indicated in table 4 show that after a period of inanition the abdominal chromaphil body is markedly increased in dimensions but does not stain as deep a brown as does that of a normal animal. Read previous paragraph here.

My method of procedure was as follows: The weighed glad was ground up in a mortar with purified sand; to this 1.5 cc. of a 0.1N.HCl solution was added and rinsed into a conical flask with 4.5 cc. of water. The acid mixture was then heated to boiling and 5 cc. of a 10% solution of Na acetate was added to precipitate the proteins. The mixture was then filtered and the filtrate collected into a 100 cc. measuring flask. At the same time 1 cc. of a standard uric acid solution was pipetted into another 100 cc. flask. To each flask 2 cc. of uric acid reagent was added as well as 20 cc. of standard solium carbonate solution.

After standing for two or three minutes the solutions were diluted to the 100c.c. mark, shaken and the colour comparison made with a Kober colorimeter with the uric acid standard atn20 mm.

In this investigation I utilized 17 rats in all. Six were used as controls. Five were killed after 2-3 days starvation. Six were killed after 10-13 days starvation.

Table 5 and 6 give the average percentage of the body weight of the organs of the rats and the adrenin content of the adrenals.

The results confirm those of my previous investigation namely that during the early stages of inanition there is an increase in the amount of adrenin in the adrenal bodies and that during the later stages the amount of adrenin is greatly reduced.

Throughout my investigation I have noticed that the thyroids as well as the adrenals hypertrophy during inanition. This result has been obtained so constantly ~~in this investigation~~ that I sectioned the thyroids of these inanition rats. I found that the thyroid colloid substance which is normally contained in the vesicles was almost entirely lacking.

Herring (4) found that the average content of 13 male rats' adrenals was 0.224p.c. adrenin. The figure for adults was 0.25p.c. His rats were of various ages. Kuriyama(5) used five male and six females which were nearly all adult. His percentage of adrenin content was 0.26p.c. Both the above results were obtained by Folins method. The average percentage of adrenin content of my controls is 0.27%.

To ascertain whether the effects of inanition upon the adrenals were permanent or temporary I starved two rats for a period of twelve days and then restored them to their normal weight. I found that there was no hypertrophy and that the adrenin content of the glands was normal.

Discussion:

The chief theories of modern times in regards to the function of the adrenal glandsapply only to the chromaphil tissue . It has been supposed that adrenin is continuously being poured out and exercises a tonic influence upon the sympathetically innervated organs and tissues and so helps in the maintenance of the normal blood pressure(6). A more recent view is that the secretion of adrenin is only of service in certain physiological emergencies.(7) A later investigator(8) formulated the the theory that thyroid and adrenal bodies form part of mechanism for the chemical heat regulation of the body and that the cortical adrenal and chromaphil tissue both take part in this functional activity. McCarrisons recent discovery already referred to demonstrated that the adrenals have a metabolic function in the body.

The question now remains to be answered , 'How do the adrenals control the metabolism of the body during starvation?' and 'Why should there be an first increase and then a decrease in the adrenin content of the adrenals of a starving animal?'

To answer the first question let us consider

the action of adrenin . It has a marked influence upon the calibre of the blood vessels. If Ic.c. of a ~~1 in~~ 1/ 10000 solution of this substance is injected into the blood stream there is amarked constriction of of the arterioles with the exception of those of the brain the lungs, the coronary circulation and the adrenal glands themselves. When this substance is liberated in the blood stream the artrial pressure rises and the blood which may be regarded as the metabolic messenger is driven at a much greater pace and thus in greater quantity through any part of the body in which the vessels are maintained in the normally dilated condition, or where there are no vaso-motornerves as in the vessels of the brain the lungs and the coronary circulation. It is therefore not surprising that we find an increased amount of adrenin and hypertrophy of the adrenals during the early stages of inanition , the obvious purpose being to maintain the metabolism and thus the function of the most vital organs in the animal economy namely the brain the lungs and the heart. It is on account of this defensive mechanism that we find practically no loss of substance in the heart the lungs and the brain during starvation. Thus the adrenals follow Wiegert's principle of hypertrophy due to increased function which is thrown upon them in times of stress as during inanition.

To answer the second question as to why there should be first an increase and then a decrease in the adrenin content of the adrenals of a starving animal let us briefly consider metabolism during starvation.

During the first one or two days the carbohydrate reserve which is present chiefly as glycogen in the muscle and liver of the body is consumed. Elliot and Cramer have shown that an increased discharge of adrenin in a normal animal causes hyperglycaemia and glycosurea due to the fact that the adrenin liberated passes to the liver and muscle and causes a rapid mobilization of the stored up glycogen. It is obvious that during the early stages of inanition the means adopted by the body to mobilize its glycogen is by a hypersecretion of adrenin. A greater amount of adrenin than is necessary for normal metabolism is thus poured out during inanition. This explains the increasein the adrenin content of the adrenals during the early stages of inanition. During the later period of starvation when the food reserve has been consumed we find that the adrenin content is very much diminished. Thisdiminution may be explained in one of two ways either the adrenin is discharged as soon as it is formed, or the body is so impoverished by starvation that the substances necessary for the production of adrenin are lacking.

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Table I. Comparison of Weights of Organs of Normal and Inanition White Rats

	Normal Animals		Inanition Animals 2-3 days		Inanition Animals 10-12 days	
	Males (3)	Females (3)	Males (2)	Females (3)	Males (4)	Females (2)
Average total weight	207 gm.	176.5 gm.	(212 gm (189 gm	210 gm 192 gm	264 gm 172 gm	247 gm. 164 gm
Brain	0.925%	0.887%	0.916%	0.875%	0.968%	0.900%
Lungs	0.596	0.612	0.555	0.588	0.602	0.687
Heart	0.474	0.502	0.470	0.491	0.556	0.598
Spleen	0.199	0.235	0.189	0.201	0.170	0.189
Adrenals	0.01670	0.0170	0.0188	0.0190	0.0565	0.060
Thyroids	0.0152	0.0153	0.0160	0.0172	0.420	0.423
Liver	5.62	5.76	5.00	4.947	3.071	3.10
Testes	1.253	-	1.223	-	1.022	-
Ovaries	-	0.027	-	0.025	-	0.023
Kidneys	0.830	0.845	0.822	0.832	0.829	0.833
Submaxillary glands	0.342	0.322	0.324	0.309	0.260	0.267

Table II. Adrenin Content and Adrenal Weight compared with Body Weight, in Normal and Inanition Rats

No.	Period of starvation	Weight before starvation	Weight when killed	Weight of Adrenals	Adrenin content of adrenals
1	-	-	200.0 gm.	0.0320 gm.	0.093 mg.
2	-	-	209.5	0.0365	0.086
3	-	-	213.5	0.0346	0.094
4	-	-	169.0	0.0304	0.092
5	-	-	185.0	0.0296	0.088
6	-	-	175.5	0.0297	0.094 mg., mean 0.094 mg.
7	69 hours	201.5 gm.	180.0	0.0342	0.132
8	70	222.5	198.0	0.0368	0.141
9	67	186.0	178.5	0.0339	0.134
10	72	242.0	230.5	0.0432	0.143
11	65	202.0	187.0	0.0344	0.128 mg., mean 0.135 mg.
12	10 days	241.0	165.0	0.0924	0.035
13	11	280.0	192.5	0.1094	0.030
14	10	265.0	176.0	0.0993	0.027
15	10	270.0	154.5	0.0870	0.033
16	12	268.5	176.5	0.1056	0.040
17	12	226.0	151.5	0.0899	0.031 mg., mean 0.032 mg.

Table I A. Table showing Percentage of Body Weight of Organs of Normal Pigeons

No.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Sex	F	M	M	F	F	M	M	Average %
Weight -	312 gm	417.5	437.3	397.3	384.7	432.9	398.7	
Thyroids -	.031%	.024%	.026%	.024%	.023%	.023%	.023%	.025%
Liver -	2.485	1.68	2.340	2.24	1.921	2.14	1.865	2.096
Spleen -	.051	.012	.032	.019	.064	.098	.0098	.041
Kidneys -	.874	.619	.724	.619	.671	.515	1.105	.732
Pancreas -	.474	.198	.418	.231	.356	.275	.349	.329
Heart -	1.483	1.392	1.369	1.177	1.29	1.13	1.38	1.317
Testicles-	-	.415	.032	-	-	.579	.593	.405
Ovaries -	.321	-	-	.304	.217	-	-	.281
Brain -	.654	.522	.492	.558	.572	.505	.566	.553
Adrenals-	.0108	.0074	.011	.013	.0061	. 0100	.0058	.0090

Table II A. Table Showing Percentage of Body Weight of Organs of Normal Dogs

No.	(1)	(2)	)3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Sex	M	M	M	M	M	M	M	M	M	M	F	F	F	F	F	F	F
Weight -	14.0 kg.	8.5 kg	14.5 kg	6.5 kg	12.25 kg	10 kg	16.5 kg	11 kg	19.5 K.	15.5K	13 K	11.5 K	13.5 K	12.5 K	13.5K	15.0K	16 K.
Heart -	0.785%	0.747%	0.651%	1.10%	0.837%	0.707%	0.7211%	0.867%	0.746%	0.9568%	0.759%	0.9123%	0.721%	0.8214%	0.69%	0.7125%	0.684%
Pancreas -	0.175	0.214	0.325	0.252	0.297	0.209	0.404	0 .229	0.240	0.1854	0.340	0.212	0.184	0.1999	0.137	0.2792	0.201
Liver -	2.547	3.329	5.83	3.90	2.68	5.036	6.839	3.722	2.922	4.46	5.17	4.862	2.88	4.223	1.81	2.931	3.038
Thyroids -	0.047	0.033	0.020	0.087	0.0246	0.0262	0.04246	0.017	0.023	0.0195	0.036	0.040	0.037	0.028	0.017	0.032	0.010
Adrenals -	0.013	0.014	0.019	0.019	0.0135	0.0155	0.019	0.015	0.0095	0.0124	0.0165	0.021	0.023	0.022	0.019	0.015	0.012
Thymus -	0.052	0.049	0.031	0.061	0.044	0.034	0.038	0.089	0.082	0.0353	0.117	0.0703	0.049	0.103	0.051	0.097	0.071
Submaxillary Glands -	0.086	0.093	0.119	0.28	0.092	0.099	0.101	0.098	0.113	0.08995	0.152	0.083	0.025	0.1014	0.052	0.097	0.094
Parotid Glands-	0.073	0.060	0.059	0.079	0.071	0.063	0.0787	0.055	0.103	0.0712	0.088	0.065	0.025	0.09	0.017	0.081	0.033
Sublingual Glands -	0.0125	0.025	0.034	0.025	0.017	0.011	0.044	0.058	0.033	0.0239	0.015	0.022	0.023	0.020	0.013	0.024	0.012
Kidneys -	0.449	0.730	0.770	0.710	0.442	0.488	0.4634	0.686	0.394	0.4477	0.703	0.694	0.570	0.476	0.403	0.399	0.466
Ovaries -	-	-	-	-	-	-	-	-	-	-	0.022	0.033	0.019	0.017	0.013	0.020	0.023
Testicles -	0.109	0.021	0.033	0.179	0.077	0.127	0.116	0.169	0.053	0.0836	-	-	-	-	-	-	-
Epididymes -	0.041	0.010	0.012	0.042	0.028	0.031	0.043	0.0341	0.014	0.024	-	-	-	-	-	-	-
Spleen -	0.205	0.223	0.177	0.49	0.20	0.306	0.219	0.312	0.182	0.1845	0.215	0.195	0.168	0.213	0.150	0.147	0.028

Table Showing Percentage of Body Weight of Organs of Normal Dogs

)	(2)	)3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	
	M	M	M	M	M	M	M	M	M	F	F	F	F	F	F	F	F	
kg.	8.5 kg	14.5 kg	6.5 kg	12.25 kg	10 kg	16.5 kg	11 kg	19.5 K.	15.5K	13 K	11.5 K	13.5 K	12.5 K	13.5K	15.0K	16 K.	9.5 K	Average %
35%	0.747%	0.651%	1.10%	0.837%	0.707%	0.7211%	0.867%	0.746%	0.9568%	0.759%	0.9123%	0.721%	0.8214%	0.69%	0.7125%	0.684%	0.7342%	0.786%
75	0.214	0.325	0.252	0.297	0.209	0.404	0 .229	0.240	0.1854	0.340	0.212	0.184	0.1999	0.137	0.2792	0.201	0.1939	0.233
17	3.329	5.83	3.90	2.68	5.036	6.839	3.722	2.922	4.46	5.17	4.862	2.88	4.223	1.81	2.931	3.038	3.845	3.855
47	0.033	0.020	0.087	0.0246	0.0262	0.04246	0.017	0.023	0.0195	0.036	0.040	0.037	0.028	0.017	0.032	0.010	0.039	0.932
13	0.014	0.019	0.019	0.0135	0.0155	0.019	0.015	0.0093	0.0124	0.0165	0.021	0.023	0.022	0.019	0.015	0.012	0.029	0.017
52	0.049	0.031	0.061	0.044	0.034	0.038	0.089	0.082	0.0353	0.117	0.0703	0.049	0.103	0.051	0.097	0.071	0.080	0.064
86	0.093	0.119	0.28	0.092	0.099	0.101	0.098	0.113	0.08995	0.152	0.083	0.025	0.1014	0.052	0.097	0.094	0.194	0.109
73	0.060	0.059	0.079	0.071	0.063	0.0787	0.055	0.103	0.0712	0.088	0.065	0.025	0.09	0.017	0.081	0.033	0.066	0.066
125	0.025	0.034	0.025	0.017	0.011	0.044	0.058	0.033	0.0259	0.015	0.022	0.023	0.020	0.013	0.024	0.012	0.025	0.024
49	0.730	0.770	0.710	0.442	0.488	0.4634	0.686	0.394	0.4477	0.703	0.694	0.570	0.476	0.403	0.399	0.466	0.569	0.537
	-	-	-	-	-	-	-	-	-	0.022	0.033	0.019	0.017	0.013	0.020	0.025	0.023	0.021
09	0.021	0.033	0.179	0.077	0.127	0.116	0.169	0.053	0.0836	-	-	-	-	-	-	-	-	0.097
41	0.010	0.012	0.042	0.028	0.031	0.043	0.0341	0.014	0.024	-	-	-	-	-	-	-	-	0.028
05	0.223	0.177	0.49	0.20	0.306	0.219	0.312	0.182	0.1845	0.215	0.195	0.168	0.213	0.150	0.147	0.028	0.0195	0.222

Table III A. Table showing Percentage of Body Weight of Organs of Normal Rats

No.	(1)	(2)	(3)	(4)	(5)	)6)	(7)	(8)	Aver age %
Sex	M	M	M	M	M	M	M	F	
Weight -	120.9 gm.	180.6	211.2	190.0	187.8	155.3	163.5	137.0	
Brain -	1.106%	0.8654	0.7993	0.8690	0.8584	0.9215	0.7821	1.086	0.911
Lungs -	0.3902%	0.4104	0.5037	0.5089	0.4825	0.4213	0.4821	0.6276	0.471
Heart -	0.5225%	0.4250	0.4398	0.4662	0.4815	0.4521	0.4932	0.4763	0.47(
Spleen -	0.1582%	0.2009	0.1842	0.1879	0.2130	0.1892	0.2132	0.2713	0.20(
Adrenals -	0.002016%	0.01612	.01515	.01056	.01491	.01721	.01321	.02598	.01(
Thyroids -	0.03155%	0.01157	.01515	.01421	.01651	.01931	.01231	.01043	.01(
Liver -	4.260%	4.557%	6.524	4.419	4.760	5.322	6.223	5.941	5.25(
Testicles -	1.215%	1.031	1.994	1.3161	1.841	1.521	1.721	-	1.52(
Ovaries -	-	-	-	-	-	-	-	0.05439	.05(
Kidneys -	0.7236%	0.9682	1.124	0.8808	0.8969	0.9921	0.8743	0.8592	0.91
Submaxillaries	0.3304%	0.2530	0.2837	0.3222	0.3100	0.2915	0.3214	0.2745	0.29

Table I B. Table showing Percentage of Body Weight of Organs of Inanition Pigeons

No.	(1)	(2)	(3)	(4)	(5)	(6)	
Sex	M	M	M	F	F	F	Average %
Weight -							
Normal	357.2 gm	376.7	387.5	350.1	359.6	364.2	
After Inanition	183.0 gm	260.5	267.3	235.3	259.5	272.4	
Thyroids -	0.04109%	0.03813	0.02937	0.03518	0.06714	0.04512	0.0416
Liver -	3.385	2.139	3.311	2.1071	1.5321	1.6523	2.378
Spleen -	0.02956	0.02994	0.02907	0.03206	0.03125	0.02994	0.0300
Kidneys -	1.044	0.4567	0.6551	0.7521	0.5597	0.6494	0.686
Pancreas -	0.4149	0.1754	0.1999	0.2973	0.2411	0.2149	0.257
Heart -	2.314	1.540	1.278	1.3391	1.4330	1.3821	1.548
Testicles-	0.02508	0.1527	0.08776	-	-	-	0.0885
Ovaries -	-	-	-	0.2637	0.2767	0.2534	0.2646
Brain -	1.163	0.9033	0.7969	0.8939	0.7743	0.8121	0.890
Adrenals -							
Of In. anition	0.03922	0.01563	0.02110	0.02558	0.02396	0.02945	0.0259
Of Normal	0.0201	0.01075	0.01455	0.0172	0.01730	0.0220	0.017

Table II B. Table showing Percentage of Body Weight of Inanition Dogs

No.	(1)	(2)	(3)	(4)	
Sex	F	F	M	F	Average %
Heart -	0.714%	0.939%	0.929%	0.885%	0.876%
Pancreas -	0.176	0.171	0.204	0.258	0.202
Liver -	3.217	3.67	3.37	3.357	3.404
Thyroids -	0.037	0.029	0.039	0.035	0.035
Adrenals -	0.0274	0.034	0.0249	0.038	0.0311
Thymus -	0.016	0.020	0.026	0.018	0.020
Submaxillary Glands-	0.108	0.134	0.166	0.119	0.132
Parotid Glands -	0.048	0.021	0.0457	0.041	0.039
Sublingual Glands -	0.015	0.0195	0.026	0.0214	0.021
Kidneys -	0.491	0.697	0.6081	0.57	0.592
Ovaries -	0.013	0.0183	-	0.011	0.014
Testicles -	-	-	0.149	-	0.149
Epididymes -	-	-	0.2	-	0.020
Spleen -	0.295	0.292	0.269	0.227	0.271
Weight before Starvation	13 K.	15.5K	17 K.	9.75 K	
Weight after Starvation	11 K.	10.25K	12 K.	7.00 K	
Number of days Starved	30	20	20	14	

Table III B. Table showing Percentage of Body Weight of Organs of Inanition Rats (7-10 Days)

No.	(1)	(2)	(3)	(4)	(5)	
Sex	M	M	M	M	M	Average %
Weight -						
Normal	231.5 gm.	345.0 gm	254.0 gm	280.5 gm	150.0 gm	
After Inanition	152.5	235.0	158.2	200.0	110.0	
Brain -	1.042%	0.791%	1.016%	0.910%	0.938%	0.939%
Lungs -	0.407	0.415	0.446	0.435	0.418	0.424
Heart-	0.447	0.497	0.508	0.609	0.727	0.556
Spleen -	0.118	0.1652	0.141	0.179	0.196	0.160
Adrenals -	0.046	0.057	0.052	0.074	0.046	0.055
Thyroids -	0.037	0.0306	0.044	0.035	0.0208	0.034
Liver -	2.66	2.52	2.535	2.618	3.126	2.71
Testicles -	0.9247	0.9226	1.067	1.175	-	1.022
Ovaries -	-	-	-	-	0.421	0.421
Kidneys -	0.907	0.7015	0.929	0.984	0.824	0.869
Submaxillaries -	0.213	0.238	0.252	0.198	0.221	0.260

Table IV. Size of Chromaphil Bodies in Normal Dogs

No.	Sex	Weight	Size of Chromaphil Bodies
1.	Male	12.5 K.	34 mm by 1.5 mm.
2.	Male	14 K.	31.7 mm by 1.9 mm.
3.	Male	14.5 K.	36 mm by 1.5 mm.
4.	Male	9 K.	41 mm by 2 mm.
5.	Male	16 K.	35 mm by 2.5 mm.
6.	Male	12.25K.	35 mm by 2 mm.
7.	Male	18.5 K.	42 mm by 3 mm.
8.	Female	7 K.	38 mm by 1.5 mm
9.	Female (fat)	24.5 K.	33 mm by 1.5 mm.
10.	Female	13.25K.	40 mm by 2 mm.
11.	Female	11.75K.	32 mm by 1.25 mm.
12.	Female	8 K.	30 mm by 1.2 mm.

The inanition animal weighed 12 kg. Its chromaphil body measured 50 mm. long by 2.5 mm. wide.

It did not stain quite as darkly as did the others.

III.

The Action of Various Anions on the Frog's Heart and Muscle-nerve Preparations

This series of experiments was carried out with the object of ascertaining the relative physiological actions of the Anions Fluoride, Chloride, Bromide, Iodide, Iodate, Nitrate, and Chlorate, upon excised frogs' hearts and muscle-nerve preparations at different temperatures and in different concentrations.

I carried out thirteen experiments in all. In the first my results were contaminated by silicates but the next twelve were successful. In each experiment except the last I utilised 36 frogs and in the last I used 144 frogs.

I prepared solutions of the Sodium salts of these anions as indicated in Table I - all being modifications of the Ringer solution except the one containing the NaCl which is itself the Ringer solution.

TABLE I

NaCl Solution (Ringer's Solution)		NaBr Solution
NaCl -	7.5 grams	NaBr - 13.2 grams
$NaHCO_3$ -	0.1 "	(The NaBr replaces the
KCl -	0.075 "	NaCl of the Ringer's
$CaCl_2$ -	0.15 "	solution)
Glucose -	1.0 "	
H_2O to 1000 c.c.		

NaI solution

NaI - 19.23 grams

(NaI replaces the NaCl of Ringer's solution)

$NaIO_3$ solution

$NaIO_3$ - 26.0 grams

($NaIO_3$ replaces the NaCl of Ringer's solution)

$NaNO_3$ solution

$NaNO_3$ - 10.9 grams

($NaNO_3$ replaces the NaCl of Ringer's solution)

$NaClO_3$ solution

$NaClO_3$ - 13.65 grams

($NaClO_3$ replaces the NaCl of Ringer's solution

NaF solution

NaF - 5.58 grams

(NaF replaces the NaCl of Ringer's solution)

The Chemicals used are as follows:

NaCl - Kahlbaum - purest "zur analyse"

$NaHCO_3$ - " " " "

KCl - " " " "

$CaCl_2$ - " " " "

Glucose - Merk - pure

NaBr - " U. S. P.

NaI - " " " "

$NaIO_3$ - " " " "

$NaClO_3$ - " " " "

$NaNO_3$ - " " " "

NaF - " " " "

It will be noticed that the quantities of the salts substituted for NaCl in the Ringer solution are directly proportional to their molecular weights, thus ensuring the same number of ions, volume for volume, as in the Ringer solution and thus keeping the new solutions isotonic with the frog tissues.

I weighed the frogs used, and after pithing dissected out the hearts and muscle-nerve preparations. I labelled and immersed them in the different solutions as indicated in the records of the experiments.

I found, as well be seen from the results, that temperature had a very marked effect upon the survival period of the preperations, so that it was necessary to contrive a means of maintaining a constant temperature for a lengthy period. Professor Cameron's suggestion of using running water overcame this difficulty and in all my experiments the temperature never varied more than 1° C. over a period of ten days. The large range of temperatures at which the different experiments were carried out, were obtained by watching the temperature of the running water for almost a year and carrying out each experiment at the desired temperature.

In the course of my work, I found that the most efficient method of preparing a muscle-nerve preparation is as follows:-

The frog is pithed, the skin divided about the abdomen and removed with the aid of a hook. The frog is then taken by the feet, a pair of bluntly pointed scissors introduced between both gastrocnemii muscles and the tibio-fibulae. The latter are snipped at their proximal ends and then the calcaneal tendons are cut. The sciatic nerve which supplies each gastrocnemius, is then isolated, a tag tied to its proximal end and the femur divided at its distal extremity. By the above method two muscle nerve preparations may be isolated within a minute and a half. The heart of each frog is also labelled and excised.

During the course of each experiment the time of survival of each muscle-nerve preparation and heart was recorded from time to time and the results tabulated.

To test whether a heart was still alive, I touched it with the electrode of an inductorium; if it failed to contract, then I took it as dead.

With the muscle-nerve preparations there was both the nerve and the muscle substance to consider. I also used faradic stimulation here and found that invariably the nerve died before the muscle substance.

All the solutions used have the same number of ions per unit volume. The different percentages of solution of the different anions used, are made

up by using the Ringer NaCl solution for dilution. For example 100 c.c. of a 5% solution of NaI would contain 5 c.c. of the original NaI solution (Table I) and 95 c.c. of the original NaCl solution. This method of preparing the percentage solutions is necessary to maintain a constant number of ions in the solution so that isotonicity is not upset and the results thus comparable when different strengths of the anions are used.

Previous Work related to these Experiments

Although there is an enormous amount of literature on the effects of cations upon the skeletan and cardiac muscles of MAMA, no work has been done to determine the relative physiological action of a family of anions (Halides) upon the muscles.

Theophile Kraus in his paper on "The Role of the Bromide Salts on the rhythmically contracting Organs" (Jour. of Pharmacol. and Expt. Therap. Oct. 1919) found that a Bromide Ringer-Locke solution is adequate to maintain rhythmicity in a perfused isolated mammalian heart as long a time as a similar chloride solution.

My experiments on frogs' hearts have shown that the Bromide Ringer solution is not as efficient as the Chloride solution as far as the survival period is concerned. (See "Survival-concentration" curves).

I have plotted the following curves from the data of the experiments.

1. Survival-temperature curves of hearts and muscle-nerve preparations. I used the original preparations of the anions (Table I) and compared the time of survival of the preparations with the rise of temperature.

Conclusion: (1) The survival period of both the hearts and the muscle-nerve preparations in all the solutions increases with decrease in temperature.

2. Survival-concentration curves. These curves show the period of survival of the hearts and muscle-nerve preparations in different concentrations of the same anion and also compare the period of survival of these organs in the different anion solutions of the same concentration.

Conclusion: (1) Comparing the survival periods of the hearts and muscle-nerve preparations in the different anion solutions of the same strength I find that the survival period is greatest with chloride, least with fluoride and ranges in decreasing time limits with bromide, chlorate, nitrate, iodide, and iodate in the order mentioned. Hence, expressed in toxicity we have the following order:- F (most toxic) IO_3 I NO_3 ClO_3 Br Cl (least toxic) (See conclusion (3))

(2) Taking the survival periods obtained with the original NaCl solution as the maximum, it is found that the time of survival of

both the hearts and the muscle-nerve preparations in each anion solution, increases as the NaCl content increases.

(3) In conclusion (1) I stated that with reference to toxicity that IO_3 I NO_3. This relation between these three anions is only true above certain concentrations of the anions I and IO_3. In the case of the Iodide, it remains more toxic than the Nitrate solution above the 5% concentration of NaI but below that concentration the Nitrate solution is more toxic than the Iodide solution. In the case of the Iodate, it remains more toxic than the Nitrate solution above 1/8 to 1/10%, but below that concentration the Nitrate solution is more toxic than the Iodate solution.

Rhythmical Fibrillation of Muscle

It was noticed regularly, when a muscle-nerve preparation was put into the original Iodide or Fluoride solution, that it began to contract rhythmically.

To test whether this effect was directly upon the muscle substance or upon the nerve, curare was added. In the case of the Iodide solution the contractions were abolished but not so in the case of the Fluoride solution.

Conclusion:

In the case of the Iodide solution the Fibrillation is due to an effect by the solution upon the nerve; in the case of the fluoride solution the effect is directly upon the musole substance.

Experiment II

Temp. 8° C. I. 100% NaCl Medium

Time of Survival in Hours.

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45 gm.	49.15	172.20	173.15	170.17	170.52
2.	48.5 gm.	50.	167.17	169.27	165.35	168.30
3.	39.5 gm.	55.30	161.25	163.13	169.57	162.32
4.	40 gm.	51.25	171.22	171.22	169.22	170.47
5.	47.5 gm.	49.	170.28	171.01	169.17	170.07
6.	60 gm.	53.45	160.30	160.35	168.06	168.31
7.	58 gm.	57.21	172.46	171.05	171.51	169.47
	Mean	52.20	169.34		168.56	
	Max.	57.21	172.46		171.51	
	Min.	49.	167.17		162.22	
Limit of error		10%	2%		3%	

Experiment II

Temp. 8° C. II. NaBr Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	43 gm.	33.25	122.45	123.10	121.50	122.27
2.	45 gm.	32.47	121.50	122.40	120.45	121.40
3.	49.5 gm.	32.	121.12	123.25	120.12	122.40
4.	46 gm.	32.30	122.55	123.20	121.50	122.32
5.	60 gm.	32.	123.55	123.22	122.45	122.27
6.	55 gm.	30.26	122.05	122.	120.52	120.55
7.	62 gm.	32.55	123.20	123.	122.25	121.25
	Mean	32.17	122.08		121.46	
	Max.	33.25	123.55		122.45	
	Min.	30.26	121.50		120.52	
Limit of error		6%	1%		1%	

Experiment II

Temp. 8° C. III. NaI Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45 gm.	8.05	45.55	45.25	44.35	43.43
2.	54 gm.	7.45	46.20	46.	44.45	44.30
3.	47 gm.	7.45	44.30	44.45	43.15	43.01
4.	39.5 gm.	7.30	45.52	45.52	44.35	44.50
5.	50 gm.	7.30	45.30	45.55	43.35	44.20
6.	40.5 gm.	8.	46.25	45.55	45.32	45.20
7.	57 gm.	7.37	45.35	45.07	44.30	44.12
	Mean	7.36	45.40		44.24	
	Max.	8.05	46.25		45.32	
	Min.	7.30	44.30		43.07	
Limit of error		20%	2%		2%	

Experiment II

Temp. 8° C. **IV. $NaClO_3$ Medium**

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R. Nerve	L.Nerve
1.	48 gm.	17.45	71.37	71.40	70.16	70.58
2.	43 gm.	17.30	73.30	74.42	72.50	73.27
3.	53 gm.	17.27	71.40	70.45	70.45	70.02
4.	42 gm.	16.50	73.20	74.32	71.42	71.10
5.	58 gm.	18.10	75.20	74.50	73.45	73.
6.	51 gm.	16.50	70.50	71.25	70.07	71.40
7.	62 gm.	17.15	72.35	72.25	71.52	72.
	Mean	17.17	73.30		71.35	
	Max.	18.10	75.20		73.27	
	Min.	16.50	70.45		70.07	
Limit of error		5%	5%		2%	

Experiment II

Temp. 8° C. V. $NaNO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	40 gm.	14.35	62.35	61.55	61.35	60.35
2.	53.5 gm.	16.20	63.52	62.20	62.23	62.04
3.	48 gm.	14.21	64.45	64.25	63.35	63.39
4.	48.5 gm.	14.02	61.10	60.55	60.35	60.05
5.	47.5 gm.	15.40	62.42	63.	62.10	62.05
6.	45.5 gm.	15.	61.	61.47	60.12	60.47
7.	50. gm.	15.50	64.15	61.02	63.25	60.20
	Mean	15.09	62.32		61.44	
	Max.	16.20	64.15		62.23	
	Min.	14.02	60.55		60.35	
Limit of error		7%	3%		1%	

Experiment II

Temp. 8° C. VI. NaF Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	55 gm.	10.	1.25	1.20	1.	1.02
2.	47 gm.	9.	1.27	1.32	1.12	.57
3.	53.5 gm.	11.	1.29	1.40	1.02	1.20
4.	39 gm.	8.	1.25	1.15	1.12	.52
5.	49 gm.	6.	1.36	1.17	.46	1.
6.	42.5 gm.	11.	1.25	1.15	1.02	1.04
7.	47 gm.	7.	1.30	1.20	1.03	.57
	Mean	8.	1.26		1.15	
	Max.	11.	1.40		1.20	
	Min.	7.	.56		.57	
Limit of error		20%	20%		20%	

Experiment III.

Temp. 5° C. I. 100% NaCl Medium - 50% Dil.

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	49.5 gm.	47.45	170.35	172.35	169.42	171.10
2.	57 gm.	45.50	170.	170.50	168.35	169.35
3.	64 gm.	46.45	173.50	172.52	172.	171.45
4.	63 gm.	48.25	169.10	167.45	167.25	166.55
5.	60 gm.	47.45	170.30	170.40	169.12	169.35
6.	48 gm.	46.50	175.	173.55	173.	172.37
	Mean	47.13	171.53		170.03	
	Max.	48.25	175.		173.	
	Min.	45.50	167.45		166.55	
Limit of error		5%	2.5%		1.75%	

Experiment III

Temp. 5° C. II. 50% NaCl. 50% NaBr Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	43 gm.	36.50	143.	143.40	141.53	142.47
2.	48.5 gm.	35.50	140.45	141.52	139.40	140.42
3.	49 gm.	34.35	143.45	142.10	142.05	140.45
4.	54 gm.	36.52	142.45	143.	141.27	141.
5.	47 gm.	34.15	139.37	141.	138.25	139.35
6.	43 gm.	35.	142.10	141.	140.40	139.32
	Mean	35.30	142.23		141.10	
	Max.	36.52	143.45		142.47	
	Min.	34.35	139.37		138.25	

Limit of error 3%

Experiment III

Temp. 5° C. III. 50% NaCl. 50% NaI Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	52 gm.	11.57	64.02	62.40	62.32	61.45
2.	44.5 gm.	11.30	64.41	63.42	63.42	62.40
3.	57 gm.	12.05	61.45	61.10	60.35	60.12
4.	60 gm.	12.17	63.57	63.40	62.45	62.28
5.	61 gm.	12.20	60.55	61.36	60.15	61.13
6.	42 gm.	11.55	62.55	64.37	61.25	63.
Mean		12.	62.55		61.50	
Max.		12.17	64.41		63.42	
Min.		11.30	60.55		60.15	
Limit of error		1%	3%			

Experiment III

Temp. 5° C. IV. 50% NaCl 50% $NaClO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	46 gm.	20.27	80.35	80.35	79.35	79.35
2.	43 gm.	20.30	81.47	82.10	80.40	81.05
3.	45 gm.	21.	82.50	82.40	81.50	81.51
4.	49.5 gm.	21.30	80.22	80.37	79.47	79.22
5.	58 gm.	21.45	79.02	81.10	78.37	79.47
6.	48 gm.	20.37	81.07	81.	79.30	79.27
	Mean	20.58	81.09		80.06	
	Max.	21.45	82.50		81.57	
	Min.	20.27	79.02		78.37	
Limit of error			2.5%		2.5%	

Experiment III

Temp. 5° C. V. 50% NaCl 50% $NaNO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	52 gm.	19.27	69.45	71.10	68.50	69.27
2.	60 gm.	18.30	68.37	68.	67.50	67.50
3.	49 gm.	17.50	67.02	69.02	66.	67.40
4.	47.5 gm.	18.27	65.42	68.37	64.40	67.47
5.	48 gm.	19.	69.32	69.15	68.42	68.15
6.	40 gm.	17.27	67.50	68.55	66.52	67.40
	Mean	18.13	68.39		67.18	
	Max.	19.27	71.10		69.25	
	Min.	17.27	65.42		64.40	
Limit of error		5%	3%		3%	

Experiment III

Temp. 5° C. VI. 50% MaCl 50% NaF Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	40 gm.	1.40	4.45	4.45	4.10	4.07
2.	42.5 gm.	1.55	5.40	5.40	4.47	5.05
3.	40 gm.	1.16	5.	5.13	4.30	4.45
4.	41 gm.	1.10	4.30	5.05	4.10	4.42
5.	60 gm.	1.20	5.37	5.17	5.10	5.07
6.	62 gm.	1.35	6.06	6.17	5.50	5.57
	Mean	1.29	5.20		4.50	
	Max.	1.55	6.17		5.50	
	Min.	1.10	4.45		4.07	

Limit of error 25%

Experiment IV

Temp. 8° 5° C. I. 100% NaCl Medium 25% Dil.

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	46 gm.	44.35	162.40	162.40	161.17	161.46
2.	52 gm.	45.27	166.05	165.07	164.40	163.20
3.	51 gm.	44.45	168.32	168.30	166.55	166.25
4.	50 gm.	43.52	168.05	168.05	165.42	165.05
5.	43 gm.	46.07	167.07	167.22	164.55	165.30
6.	43 gm.	44.35	169.55	169.	167.32	167.02
	Mean	44.54	165.04		165.	
	Max.	46.07	169.55		167.32	
	Min.	43.52	162.40		161.17	
Limit of error		5%	1%		2%	

Experiment IV

Temp. 8° 5° C.

II. 75% NaCl 25% NaBr Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	48 gm.	39.40	148.40	149.15	147.35	146.50
2.	46 gm.	39.55	151.17	151.20	148.35	150.02
3.	42.5 gm.	39.	144.37	144.10	142.10	141.12
4.	40 gm.	38.30	149.45	149.12	147.53	147.
5.	47 gm.	38.	150.32	149.47	148.47	147.55
6.	39 gm.	39.17	149.47	148.30	148.	146.45
	Mean	39.04	149.01		146.54	
	Max.	39.42	151.20		150.02	
	Min.	38.	144.10		141.12	
Limit of error		1%	3%		3%	

Experiment IV

Temp. 8° 5° C.

III. 75% NaCl 25% NaI Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	52 gm.	15.50	72.37	74.	72.05	72.40
2.	50 gm.	15.25	71.52	71.05	70.47	69.42
3.	42 gm.	14.42	69.42	68.55	68.30	67.05
4.	40.5 gm.	15.30	70.47	70.50	69.35	69.02
5.	47 gm.	14.37	69.02	69.10	67.35	67.37
6.	48 gm.	15.15	69.12	67.47	66.47	66.32
	Mean	15.06	70.30		69	
	Max.	15.50	71.52		72.40	
	Min.	14.37	67.47		66.32	
Limit of error		4%	3%		3.5%	

Experiment IV

Temp. 8° 5° C.

IV. 75% NaCl 25% $NaClO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	60 gm.	24.40	88.50	87.40	87.37	86.32
2.	50 gm.	25.27	82.47	85.47	81.40	83.45
3.	41 gm.	24.55	86.42	86.02	84.47	83.35
4.	53 gm.	23.47	88.25	89.47	86.40	87.30
5.	57.5 gm.	24.47	87.40	88.02	86.02	85.55
6.	46 gm.	23.30	84.55	85.07	83.10	83.52
	Mean	24.32	86.49		85.05	
	Max.	25.27	89.47		87.30	
	Min.	23.30	82.47		81.40	
Limit of error		4%	5%		5%	

Experiment IV

Temp. 5^{0} 8^{0} C.

V. 75% NaCl 25% $NaNO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	40 gm.	22.	73.37	72.42	72.20	71.42
2.	38 gm.	23.37	72.42	73.12	71.	71.50
3.	42 gm.	20.45	71.15	71.45	69.22	69.40
4.	59 gm.	20.45	73.40	73.	72.02	71.40
5.	47 gm.	22.55	72	71.10	70.30	
6.	40 gm.	19.45	70.57	71.47	69.42	70.22
	Mean	21.26	72.19		70.39	
	Max.	23.37	73.40		72.02	
	Min.	19.45	70.57		69.22	
Limit of error		10%	3%		3%	

Experiment IV

Temp. 8° C. VI. 75% NaCl 25% NaF Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	44 gm.	3.20	7.42	7.30	6.35	6.25
2.	44 gm.	4.35	7.22	7.45	6.22	6.45
3.	46 gm.	2.40	7.30	8.22	6.42	7.25
4.	48 gm.	3.27	7.00	7.47	6.17	7.
5.	52 gm.	2.42	6.30	6.20	5.55	5.40
6.	41.5 gm.	3.35	6.42	6.30	6.15	5.50
	Mean	3.23	6.55		6.26	
	Max.	4.35	8.22		7.25	
	Min.	2.40	6.20		5.50	
Limit of error		50%	33-1/3%		16%	

Experiment V

Temp. 5° C. $NaNO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	42.5 gm.	13.40	60.22	61.25	59.40	60.32
2.	42 gm.	12.55	58.42	57.50	57.55	56.40
3.	42.5 gm.	14.15	61.50	60.45	60.15	59.47
4.	50 gm.	13.57	60.35	61.	59.45	59.20
5.	47 gm.	14.37	59.47	59.17	58.55	58.27
6.	42 gm.	12.45	61.40	60.12	60.10	59.30
	Mean	13.41	60.16		59.15	
	Max.	14.37	61.50		60.32	
	Min.	12.45	57.50		56.40	

Experiment V

Temp. 5° C. NaClO3 Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	48 gm.	19.32	75.35	75.52	74.50	74.30
2.	40.5 gm.	19.10	78.32	78.03	77.10	77.20
3.	58 gm.	19.25	76.45	76.05	75.37	74.45
4.	52 gm.	18.11	74.40	75.31	73.12	74.50
5.	62 gm.	19.42	77.45	76.42	76.	75.25
6.	47 gm.	20.	75.35	75.03	74.32	73.53
	Mean	19.20	76.21		75.10	
	Max.	20.	78.32		77.20	
	Min.	18.11	75.35		73.12	

Experiment VI

Temp. 15°-16° C. NaCl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45 gm.	3.15	48.32	48.32	48.10	48.10
2.	56 gm.	3.07	47.30	48.22	47.	47.35
3.	50.5 gm.	3.30	48.35	48.27	48.05	47.42
4.	55 gm.	3.30	48.58	48.32	48.20	47.42
	Mean	3.20	48.20		47.25	
	Max.	3.30	48.58		48.20	
	Min.	3.07	47.30		47.	
Limit of error		1%	1%		2%	

Experiment VI

Temp. 15°-16° C. NaBr Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	50 gm.	2.15	34.40	35.	34.	34.40
2.	45 gm.	2.10	34.20	35.	34.10	34.10
3.	45 gm.	2.25	34.55	35.	34.30	34.15
4.	65 gm.	2.15	34.37	34.55	34.12	34.30
	Mean	2.15	34.50		34.15	
	Max.	2.25	35.		34.30	
	Min.	2.10	34.20		34.	
Limit of error		1%	1%		1%	

Experiment VI

Temp. 15°-16° C. Na I Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	40 gm.	46.	10.50	10.47	10.15	10.12
2.	45 gm.	52.	10.45	11.00	10.22	10.32
3.	65 gm.	52	10.20	10.37	10.26	10.17
4.	38 gm.	52	11.25	11.10	10.45	10.30
	Mean	50 min.	10.50		10.25	
	Max.	52	11.25		10.45	
	Min.	46	10.20		10.12	
Limit of error		8%	2%		2%	

Experiment VI

Temp. 15°-16° C. NaClO3 Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	35 gm.	1.42	14.30	14.30	14.	14.10
2.	39 gm.	1.42	14.50	14.55	14.15	14.15
3.	42 gm.	1.50	14.15	14.25	13.30	14.10
4.	45 gm.	1.35	14.30	14.40	13.47	14.10
	Mean	1.42	14.42		14.05	
	Max.	1.50	14.55		14.15	
	Min.	1.35	14.15		13.30	
Limit of error		2%	2%		2%	

Experiment VI

Temp. 15°-16° C. $NaNO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	40 gm.	2.05	18.32	18.10	18.10	17.32
2.	42.5 gm.	2.00	18.42	18.50	18.20	18.40
3.	48 gm.	2.02	18.52	18.42	18.38	18.10
4.	52 gm.	1.55	18.45	18.30	18.10	18.00
	Mean	2.00	18.40		18.20	
	Max.	2.05	18.52		18.40	
	Min.	1.55	18.10		18.10	
Limit of error		2%	2%		2%	

Experiment VI

Temp. 15°-16° C. NaF Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	39.5 gm.	9 min	34½	32½	31	29½
2.	45.5 gm.	8½	37	39	33	34½
3.	50.5 gm.	8	32	36.5	28	33½
4.	42 gm.	8½	31	35	28	33
	Mean	8.5 min	34		31.5	
	Max.	9	39		34.5	
	Min.	8	31		28	

Limit of error 17½%

Experiment VII

Temp. 25° C. NaCl Medium 100%

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	52.5 gm.	2.25	8.15	8.10	8.05	7.50
2.	40 gm.	2.20	8.05	8.12	7.40	8.02
3.	44 gm.	2.30	7.55	8.05	7.25	7.50
4.	50 gm.	2.10	8.05	8.25	7.50	8.05
5.	44 gm.	2.30	8.05	7.50	7.35	7.25
6.	47 gm.	2.55	7.45	7.40	7.10	7.10
	Mean	2.30	8.00		7.45	
	Max.	2.55	8.25		8.05	
	Min.	2.10	7.40		7.10	
Limit of error		4%	5%		10%	

Experiment VII

Temp. 25° C. NaBr Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	42 gm.	1.45	7.05	7.05	6.50	6.45
2.	30 gm.	1.40	6.50	7.00	6.25	6.35
3.	37 gm.	1.45	6.50	7.05	6.20	6.50
4.	45 gm.	1.42	6.40	6.45	6.15	6.10
5.	52 gm.	1.45	6.52	7.00	6.15	6.30
6.	47 gm.	1.35	6.55	6.55	6.20	6.15
	Mean	1.42	6.45		6.25	
	Max.	1.45	7.05		6.50	
	Min.	1.35	6.50		6.10	
Limit of error		5%	4%		5%	

Experiment VII

Temp. 25° C. Na I Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	37.5 gm.	1.00	4.05	3.50	3.47	3.25
2.	38 gm.	.52	3.45	3.42	3.25	3.27
3.	35 gm.	.67	3.34	3.45	3.25	3.20
4.	45 gm.	.55	3.20	3.35	3.15	3.25
5.	42 gm.	.47	3.52	3.52	3.35	3.40
6.	53 gm.	.60	3.55	3.55	3.40	3.30
	Mean	58 min	3.41		3.30	
	Max.	.67	4.05		3.47	
	Min.	.47	3.20		3115	
Limit of error		10%	10%		5%	

Experiment VII

Temp. 25° C. Na Cl O_3 Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	39.5 gm.	1.15	4.35	4.25	4.10	4.05
2.	35 gm.	1.20	4.35	4.27	4.20	4.15
3.	40 gm.	1.05	4.52	4.45	4.25	4.30
4.	44.5 gm.	1.30	4.30	4.27	4.05	4.10
5.	38 gm.	1.10	4.20	4.10	3.50	3.52
6.	37 gm.	1.30	4.10	4.30	3.52	4.17
	Mean	1.20	4.30		4.10	
	Max.	1.30	4.52		4.25	
	Min.	1.05	4.10		3.50	
Limit of error		10%	5%		5%	

Experiment VII

Temp. 25° C. — $NaNO_3$ Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	44 gm.	1.55	5.00	4.45	4.30	4.25
2.	43.5 gm.	1.50	4.50	4.40	4.35	4.25
3.	38.5 gm.	1.45	4.55	4.55	4.45	4.25
4.	37 gm.	2.00	5.00	4.55	4.45	4.35
5.	47.5 gm.	1.45	4.45	4.45	4.20	4.25
6.	52 gm.	1.55	4.45	5.10	4.25	4.45
	Mean	1.50	4.50		4.32	
	Max.	2.00	5.00		4.45	
	Min.	1.45	4.40		4.20	
Limit of error		20%	3%		3%	

Experiment VII

Temp. 25° C. Na F Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	42.5 gm.	7 min	24 min	24	19	21
2.	39.5 gm.	6	22	28	19	22.5
3.	55 gm.	7	25	25	21	22
4.	45 gm.	7.5	26	26	21	21
5.	52 gm.	6	22	27	19	22.5
6.	47 gm.	8	29	29	27	26
	Mean	7 min	25 min		22 min	
	Max.	8	29		27	
	Min.	6	22		19	
Limit of error		1/7	1/8		1/4	

Experiment VIII

12% - Temp. 5° C. Na Cl Medium 100%

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	48.5 gm.	54.00	222.45	222.45	210.20	210.20
2.	47 gm.	55.45	211.15	211.15	202.15	202.10
3.	53 gm.	57.40	219.20	219.20	208.10	208.10
4.	43 gm.	58.25	220.45	220.50	210.45	210.45
	Mean	56.42	219.30		212.52	
	Max.	58.25	220.50		210.45	
	Min.	54.00	211.15		202.15	
Limit of error		4%	3%		4%	

Note -This same medium was used as control for Experiments VIII and IX

Experiment VIII

Temp. 5° C. 12% Na Br 88% Na Cl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	34.5 gm.	46.35	194.45	194.15	185.15	186.10
2.	42 gm.	45.50	194.10	194.15	184.20	184.35
3.	48 gm.	45.15	192.45	191.15	183.15	183.20
4.	37.5 gm.	43.45	194.40	191.55	185.15	182.45
	Mean	45.20	193.00		184.25	
	Max.	46.35	194.45		186.10	
	Min.	43.45	191.15		182.45	
Limit of error		4%	1%		1%	

Experiment VIII

Temp. 5° C. 12% Na I 88% NaCl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	44 gm.	29.15	123.10	122.20	111.25	111.45
2.	52 gm.	27.50	121.10	121.10	111.55	111.15
3.	64 gm.	28.45	121.45	122.20	111.25	111.40
4.	58 gm.	27.20	120.45	121.55	112.20	111.25
	Mean	28.15	121.50		111.40	
	Max.	29.15	123.10		112.20	
	Min.	27.20	120.45		111.15	
Limit of error		4%	3%		2%	

Experiment VIII

Temp. 5° C. 12% Na Cl Oz 88% Na Cl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45 gm.	33.00	148.15	149.10	139.40	138.50
2.	47 gm.	32.20	147.50	146.45	138.50	137.40
3.	48 gm.	32.00	146.45	147.45	137.15	137.50
4.	58 gm.	32.35	147.45	146.40	136.50	137.40
	Mean	32.50	147.40		138.35	
	Max.	33.00	149.10		139.40	
	Min.	32.00	146.45		136.50	
Limit of error		3%	1%		2%	

Experiment VIII

Temp. 5° C. 12% $NaNO_3$ 88% Na. Cl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	64 gm.	28.45	134.45	134.50	125.35	125.50
2.	52 gm.	28.10	135.40	135.00	124.35	124.55
3.	54 gm.	29.35	134.00	134.00	124.00	124.50
4.	56 gm.	28.35	135.35	136.20	123.05	125.45
	Mean	28.45	134.35		125.15	
	Max.	29.35	136.20		125.45	
	Min.	28.10	134.00		123.05	
Limit of error		2%	2%		1%	

Experiment VIII

Temp. 5° C. 12% Na F 88% Na Cl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	55.5 gm.	12.25	22.45	22.45	20.25	20.00
2.	56 gm.	12.00	21.45	22.35	20.25	20.00
3.	48 gm.	11.55	22.15	21.45	19.25	19.30
4.	45 gm.	12.00	22.45	22.35	20.20	20.00
	Mean	12.00	22.40		20.05	
	Max.	12.25	22.45		20.25	
	Min.	11.55	21.45		19.25	
Limit of error		1%	2%		2%	

Experiment IX

Temp. 5° C. 5% Na Br and 95% Na Cl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45 gm.	50.40	200.25	199.10	190.40	191.10
2.	37 gm.	50.45	200.05	200.15	192.35	190.45
3.	52 gm.	50.00	197.00	202.30	190.45	191.45
4.	54.5 gm.	51.35	201.35	200.10	191.35	192.35
	Mean	50.45	200.05		191.25	
	Max.	51.35	202.30		192.35	
	Min.	50.00	197.00		190.40	
Limit of error		1%	1%		1%	

Note - The control was the same as in Experiment VIII.

Experiment IX

Temp. 5° C. 5% Na I 95% Na Cl Medium

Time of Survival in Hours.

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	38.5 gm.	32.45	131.35	131.30	122.35	122.00
2.	39 gm.	31.15	130.45	130.52	122.05	121.00
3.	40 gm.	32.45	131.35	131.35	121.05	120.45
4.	45 gm.	31.55	130.45	131.20	120.40	121.35
	Mean	32.10	131.15		121.30	
	Max.	32.45	131.35		122.35	
	Min.	31.15	130.45		120.40	
Limit of error		3%	1%		1%	

Experiment IX

Temp. 5° C. 5% Na Cl O_2 95% Na Cl Medium

Time of Survival in Hours

Mele	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	48.5 gm.	42.05	160.45	161.35	150.55	151.45
2.	49.5 gm.	41.00	160.15	161.00	150.05	150.40
3.	47.2 gm.	41.35	159.55	160.00	149.50	150.40
4.	45 gm.	40.50	160.40	159.45	150.10	151.35
	Mean	41.20	160.30		150.40	
	Max.	42.05	161.00		151.35	
	Min.	40.50	159.45		149.50	
Limit of error		1%	1%		1%	

Experiment IX

Temp. 5° C. 5% $NaNO_3$ 95% Na Cl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45.5 gm.	35.45	139.40	139.40	130.40	131.05
2.	52 gm.	35.00	139.10	140.00	130.30	130.00
3.	50 gm.	35.40	140.10	139.40	131.15	130.00
4.	39.5 gm.	35.05	140.45	138.45	131.05	130.20
	Mean	35.20	139.30		130.30	
	Max.	35.45	140.45		131.05	
	Min.	35.00	138.45		130.00	
Limit of error		1%	1%		1%	

Experiment IX

Temp. 5° C. 5% Na F 95% Na Cl Medium

Time of Survival in Hours.

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	57.5 gm.	24.40	49.00	49.35	40.15	40.40
2.	58 gm.	25.00	49.10	48.50	39.45	40.40
3.	44 gm.	24.45	49.00	48.55	39.50	39.50
4.	45.5 gm.	24.50	49.40	48.40	39.00	39.05
	Mean	24.50	49.05		40.00	
	Max.	25.00	49.35		40.40	
	Min.	24.40	48.40		39.00	
Limit of error		1%	1%		1%	

Experiment X

Temp. 5° C. $2\frac{1}{2}\%$ Na NO_3 $97\frac{1}{2}\%$ Na Cl Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	48.5 gm.	37.40	150.45	149.40	140.45	140.25
2.	47 gm.	38.55	149.35	149.15	140.00	140.30
3.	52 gm.	38.00	150.45	147.30	140.35	138.40
4.	44 gm.	38.00	149.50	150.00	138.50	138.05
5.	62 gm.	36.50	149.50	148.50	140.40	138.35
6.	60 gm.	36.45	149.50	149.45	139.30	139.35
7.	47.5 gm.	37.50	149.45	147.40	140.35	140.30
	Mean	37.35	149.25		139.45	
	Max.	38.55	150.45		140.40	
	Min.	36.45	147.30		138.05	
Limit of error		1%	1%		1%	

Experiment X

Temp. 5° C. **2½% Na I 97½% Na Cl Medium**

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	60 gm.	42.40	168.40	168.40	160.50	159.35
2.	62 gm.	40.55	169.40	169.55	162.35	161.45
3.	57.5 gm.	42;45	170.45	168.45	160.45	162.40
4.	48 gm.	41.35	169.05	169.30	160.02	159.00
5.	63 gm.	42.10	169.55	168.55	159.45	159.35
6.	60 gm.	42.40	170.35	171.00	160.50	160.35
7.	52 gm.	42.30	170.10	170.20	161.00	161.20
	Mean	42.15	169.42		160.42	
	Max.	42.45	171.00		162.40	
	Min.	40.55	168.40		159.35	
Limit of error		2%	1%		1%	

Experiment XI

Temp. 5° C. $NaIO_3$ 10% NaCl 90% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45.5 gm.	24.45	93.40	94.00	92.50	92.35
2.	50 gm.	24.30	94.35	94.00	94.45	94.35
3.	52 gm.	25.00	93.50	94.40	92.45	92.45
4.	60 gm.	24.10	94.45	95.30	93.35	94.20
5.	62.5 gm.	24.50	95.45	94.50	94.30	93.25
6.	64 gm.	24.35	95.40	96.35	94.40	95.00
	Mean	24.20	95.00		94.00	
	Max.	24.45	96.35		95.00	
	Min.	24100	93.40		92.35	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaIO_3$ 5% Na Cl 95%

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	42 gm.	30.30	120.45	120.45	120.30	120.30
2.	47 gm.	31.35	121.30	121.30	121.10	121.10
3.	38 gm.	30.25	121.35	121.35	121.15	121.15
4.	48 gm.	30.15	121.50	121.25	121.05	121.05
5.	52.5gm.	31.30	121.30	121.30	121.10	121.10
6.	50 gm.	30.00	121.25	121.25	121.05	121.05
	Mean	30.42	121.30		121.10	
	Max.	31.35	121.50		121.30	
	Min.	30.00	120.00		119.45	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaIO_3$ 4% Na Cl 96% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	44 gm.	33.40	133.35	133.35	133.35	133.35
2.	40 gm.	34.00	133.50	133.50	133.35	133.35
3.	37 gm.	33.15	134.00	133.30	133.10	133.10
4.	62 gm.	33.00	133.39	133.30	133.10	133.10
5.	60 gm.	33.30	133.25	133.25	133.05	133.05
6.	65 gm.	33.00	133.35	133.35	133.35	133.35
	Mean	33.15	133.45		133.25	
	Max.	34.00	134.40		133.40	
	Min.	33.00	133.00		132.35	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. **Na IO_3 3% Na Cl 97% Medium**

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45 gm.	37.40	144.40	144.40	144.15	144.15
2.	39 gm.	37.20	144.35	144.35	144.05	144.05
3.	40 gm.	37.20	144.05	144.05	143.40	143.40
4.	47 gm.	37.35	144.20	144.20	143.45	143.45
5.	52 gm.	37.15	144.00	144.00	143.35	143.35
6.	50 gm.	37.35	143.50	143.50	143.30	143.30
	Mean	37.30	144.20		143.50	
	Max.	37.40	144.40		144.10	
	Min.	37.15	143.35		143.15	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaIO_3$ 2% NaCl 98% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	44 gm.	42.30	158.50	158.50	158.25	158.25
2.	46 gm.	42.00	157.35	157.35	157.05	157.05
3.	54 gm.	42.15	157.30	157.30	157.00	157.00
4.	50 gm.	42.35	158.00	158.00	157.30	157.30
5.	52 gm.	42.40	157.45	157.45	157.15	157.15
6.	67 gm.	43.00	157.35	157.35	157.00	157.00
	Mean	42.30	157.50		157.20	
	Max.	43.00	159.00		158.40	
	Min.	42.00	157.00		156.40	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaIO_3$ 1% Na Cl 99% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	57.5 gm.	49.40	168.00	168.00	167.40	167.40
2.	50 gm.	49.25	168.45	168.45	168.00	167.00
3.	52 gm.	49.25	168.40	168.40	168.10	167.10
4.	48 gm.	49.10	168.10	168.10	168.25	167.25
5.	52 gm.	49.25	168.00	168.00	168.15	167.15
6.	47 gm.	49.30	168.30	168.30	167.25	167.25
	Mean	49.30	168.35		168.10	
	Max.	49.40	168.40		168.10	
	Min.	49.10	167.00		167.10	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaIO_3$ 1% NaCl 99½% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	56.5 gm.	54.35	179.00	179.00	178.15	178.15
2.	57 gm.	54.20	178.25	178.25	178.15	178.15
3.	47 gm.	54.35	178.30	178.30	177.35	177.35
4.	48 gm.	54.45	178.30	178.30	178.00	1 78.00
5.	48 gm.	53.35	178.40	178.40	177.40	177.40
6.	45.50gm.	53.40	178.35	178.35	178.00	178.00
	Mean	54.30	178.45		177.45	
	Max.	54.45	179.30		178.20	
	Min.	53.35	178.10		177.10	
Limit of erro		1/10	1%		1%	

Experiment XI

Temp. 5° C. $NaIO_3$ 1/10% Na Cl 99-9/10% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	40 gm.	56.45	217.45	217.45	217.20	217.20
2.	38.5 gm.	56.40	217.30	217.30	217.00	217.00
3.	42 gm	56.20	217.30	217.30	217.05	217.05
4.	52 gm.	56.45	217.45	217.45	217.10	217.10
5.	57 gm.	56.45	217.35	217.35	217.05	217.05
6.	50 gm.	56.40	217.55	217.35	217.30	217.30
	Mean	56.40	217.45		217.20	
	Max.	56.45	218.25		217.50	
	Min.	56.00	217.10		216.50	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. Na I 5% Na Cl 95% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	46 gm.	34.00	130.45	130.45	129.55	129.55
2.	39 gm.	34.00	130.20	130.20	130.00	130.00
3.	42 gm.	34.10	130.45	130.45	129.55	129.55
4.	48 gm.	34.10	130.50	130.50	130.30	130.30
5.	47 gm.	34.05	131.35	131.35	131.15	131.15
6.	57 gm.	34.15	130.50	130.50	130.30	130.30
	Mean	34.05	130.45		130.25	
	Max.	34.15	131.35		131.55	
	Min.	34.00	130.20		129.55	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. Na I 4% Na Cl 96% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	47 gm.	38.05	139.55	139.55	139.25	139.25
2.	48 gm.	38.15	140.00	140.00	139.40	139.40
3.	48 gm.	38.00	139.55	139.55	139.35	139.35
4.	47 gm	37.25	139.30	139.30	139.10	139.10
5.	50 gm.	38.05	139.10	139.10.	138.50	138.50
6.	48.5 gm.	38.10	139.55	139.55	139.30	139.00
	Mean	38.00	139.30		139.30	
	Max.	38.15	139.55		139.40	
	Min.	37.25	139.00		138.50	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. Na I 3% Na Cl 97% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	50 gm.	41.50	153.35	153.35	153.15	153.15
2.	49 gm.	42.00	154.00	154.00	153.40	153.40
3.	38.5 gm.	41.20	153.45	153.45	153.25	153.25
4.	40 gm.	41.00	153.40	153.40	153.00	153.00
5.	48 gm.	41.30	153.00	153.00	152.40	152.40
6.	52 gm.	41.25	153.30	153.30	153.10	153.10
	Mean	41.30	153.40		153.20	
	Max.	41.50	154.00		153.40	
	Min.	41.00	153.00		152.40	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. Na I 2% Na Cl 98% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	44 gm.	47.00	188.45	188.45	188.20	188.20
2.	48.5 gm.	46.15	189.00	189.00	188.40	188.40
3.	38 gm.	46.15	188.35	188.35	188.15	188.15
4.	37 gm.	46.55	188.55	188.55	188.25	188.25
5.	37 gm.	47.00	188.40	188.40	188.20	188.20
6.	52.[illegible] gm.	47.30	188.40	188.40	188.20	188.20
	Mean	46.50	188.45		188.20	
	Max.	47.30	189.20		188.40	
	Min.	46.15	188.40		188.15	

Limit of error 1%

Experiment XI

Temp. 5° C. Na I 1% Na Cl 99% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	44.5 gm.	52.05	212.30	212.30	212.10	212.10
2.	48 gm.	52.00	212.20	212.20	212.00	212.00
3.	50 gm.	52.20	212.30	212.30	212.10	212.10
4.	48 gm.	52.25	213.30	213.30	213.10	213.10
5.	52 gm.	52.30	212.25	212.25	212.05	212.05
6.	38 gm.	52.30	212.30	212.30	212.10	212.10
	Mean	52.20	212.35		212.10	
	Max.	52.30	213.30		212.40	
	Min.	52.00	212.20		211.40	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. **Na Cl Medium** **100%**

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	62.5 gm.	58.10	230.00	229.45	228.25	228.35
2.	60 gm.	57.50	228.35	230.20	227.20	228.35
3.	53 gm.	58.25	229.35	229.40	228.30	228.50
4.	52 gm.	57.35	228.30	228.25	227.30	227.35
5.	54 gm.	58.40	228.25	228.00	227.30	226.40
6.	45 gm.	58.35	227.50	228.45	226.40	227.35
	Mean	58.15	228.40	229.10	227.40	227.50
	Max.	58.50	230.40	230.20	228.40	228.50
	Min.	57.35	227.10	227.10	226.00	226.20
Limit of error		1%	1%	1%	1%	1%

Experiment XI

Temp. 5° C. $NaNO_3$ Medium 5% Na Cl 95%

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	45 gm.	38.30	139.35	139.35	139.20	139.20
2.	48 gm,	37.40	139.00	139.00	138.45	138.45
3.	40 gm.	38.00	140.00	140.00	139.40	139.35
4.	42.5 gm.	38.00	140.00	140.00	139.35	139.35
5.	43 gm.	37.45	140.00	140.00	139.30	139.30
6.	44 gm.	37.55	140.00	140.00	139.30	139.30
	Mean	38.00		139.45		139.25
	Max.	38.30		140.00		139.40
	Min.	37.40		139.00		139.20
Limit of error		1%		1%		1%

Experiment XI

Temp. 5° C. **$NaNO_3$ 4% Na Cl 96% Medium**

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	40 gm.	40.15	150.35	150.35	150.20	150.20
2.	38 gm.	40.20	150.00	150.30	149.45	150.15
3.	62 gm.	40.30	150.00	150.00	150.15	149.45
4.	60 gm.	40.40	151.25	151.25	151.15	151.15
5.	58 gm.	39.55	150.00	150.00	149.45	149.45
6.	42 gm.	40.40	150.25	150.25	150.05	150.05
	Mean	40.30		150.30		150.15
	Max.	40.15		151.25		151.15
	Min.	39.55		150.00		149.45
Limit of error		1%		1%		1%

Experiment XI

Temp. 5° C. $NaNO_3$ 3% Na Cl 97% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	43 gm.	42.35	160.25	160.25	160.10	160.10
2.	48 gm.	42.00	160.00	160.00	159.45	159.45
3.	48 gm.	42.15	160.10	160.10	159.45	159.45
4.	47.5 gm.	41.30	160.00	160.00	159.40	159.40
5.	55 gm.	42.30	160.00	160.00	159.40	159.40
6.	50 gm.	42.00	160.00	160.00	159.40	159.40
	Mean	42.10	160.05		159.45	
	Max.	42.30	160.25		160.10	
	Min.	41.30	160.00		159.40	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaNO_3$ 2% Na Cl 98% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	46.5 gm.	43.35	172.00	172.00	171.40	171.40
2.	50 gm.	43.35	172.10	172.10	171.50	171.50
3.	46 gm.	43.40	171.05	171.05	170.45	170.45
4.	45 gm.	43.30	171.40	171.40	171.20	171.25
5.	62 gm.	43.10	171.05	171.05	170.45	170.45
6.	39 gm.	43.35	171.00	171.00	170.45	170.45
	Mean	43.30	171.30		171.20	
	Max.	43.35	172.10		171.40	
	Min.	43.10	171.05		170;45	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. **$NaNO_3$ 1% Na Cl 99% Medium**

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	48.5 gm.	49.00	186.20	186.20	185.45	185.45
2.	40 gm.	48.55	186.50	186.50	186.30	186.30
3.	52 gm.	49.05	187.30	187.30	186.00	186.00
4.	56 gm.	49.00	187.00	187.00	186.40	186.40
5.	58 gm.	49.15	187.15	187.15	186.45	186.45
6.	39.5 gm.	49.05	186.40	186.40	186.20	186.20
	Mean	49.05	186.55		186.35	
	Max.	49.15	187.15		186.45	
	Min.	48.55	186.20		185.45	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaNO_3$ ½% Na Cl 99½% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	46.5 gm.	55.05	199.40	199.40	199.20	199.20
2.	45 gm.	55.000	200.00	200.00	199.30	199.30
3.	35 gm.	55.05	199.25	199.25	198.55	198.55
4.	39 gm.	54.50	200.00	200.00	199.40	199.40
5.	42 gm.	55.00	200.05	200.05	199.45	199.45
6.	40 gm.	55.05	200.10	200.10	199.40	199.40
	Mean	55.00	199.55		199.35	
	Max.	55.05	200.10		199.400	
	Min.	54.50	199.25		198.55	
Limit of error		1%	1%		1%	

Experiment XI

Temp. 5° C. $NaNO_3$ 1/10% Na Cl 99-9/10% Medium

Time of Survival in Hours

Male	Wt.	Heart	R.Muscle	L.Muscle	R.Nerve	L.Nerve
1.	57.5 gm.	55.35	212.25	212.25	212.05	212.05
2.	50 gm.	55.40	213.40	213.40	213.15	213.15
3.	40 gm.	56.00	213.00	213.00	212.40	212.40
4.	56 gm.	55.30	213.40	213.40	213.20	213.20
5.	55.5 gm.	55.50	212.40	212.40	212.30	212.30
6.	47.5 gm.	55.05	212.55	212.55	212.35	212.35
	Mean	55.40	212.55		212.30	
	Max.	56.00	213.40		213.20	
	Min.	55.05	212.25		212.05	