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UNIVERSITY OF LOUISVILLE

THE INFLUENCE OF A HIGH AND LOW VITAMIN
CONTENT IN NUTRITION

A Dissertation

Submitted to the Faculty

Of the Graduate School of the College of Liberal Arts

In Partial Fulfillment of the

Requirements for the Degree

Of Master of Science

Department of Chemistry

By

RUTH LOVELACE

1927

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THE INFLUENCE OF A HIGH AND LOW VITAMIN
CONTENT IN NUTRITION.

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INTRODUCTION.

In the bulk of experiments on animal feeding the Albino Rat has served as the experimental animal. It has been proved that any diet which brings about satisfactory growth in white rats will also cause a young child to grow satisfactorily. Therefore, much attention is given to the breeding of such rats for experimental and scientific use.

In the earlier stages of experimental work it was found that a diet which contained sufficient protein material and which yielded the proper number of calories because of the fat, sugar, and starch present, was a satisfactory diet.

Later investigations showed that animals fed on diets which corresponded in every respect to the diet mentioned above, did not thrive. The addition of certain mineral salts to the diet served to eliminate the trouble. This showed that a diet, in order to be adequate, must contain certain mineral salts in definite quantities.

When the scientists began an intensive study of the protein substances from different sources, they found that they did not all possess the same food value. Some proteins produced normal growth and some did not. Due to this fact, to-day we divide the proteins into three groups- Complete, Partially complete, and Incomplete Proteins. If an animal is fed on a diet, of which the protein quota is made from the incomplete proteins, it will not grow normally. A great many of our foods that nature gives us in abundance have present in them incomplete proteins.

Up to this time nothing but the solid constituents of the diet, that is, the fats, carbohydrates and protein had been emphasized. However, the importance of the liquid side of the diet came gradually to be appreciated. Water was quite essential for life and is of material assistance in the body processes as digestion, absorption, and excretion.

Through a series of years and by means of many carefully controlled experiments the scientific opinion was to the effect that a diet was adequate if it consisted of the proper amount and kind of carbohydrate, protein, fats, mineral and water.

It did not take long, however, for experimenters to find out that diets made up according to the above standard did not always yield satisfactory results. Quite a bit of work was done in these years and there were times when one scientist could not verify the results of another scientist. Finally, in recent years and after much research, it was definitely decided that normal growth could not be obtained on the above mentioned diet. In order that an animal should show normal growth and be free from certain disorders, its diet must contain certain substances which are called accessory food substances or vitamins.

To-day a diet in order to be adequate for growth must contain the following factors:

1. Protein
2. Carbohydrates and Fats furnishing energy.
3. Water
4. Mineral Salts
5. Vitamin A -- (Anti-Ophthalmia)
6. Vitamin B -- (Anti-Neuritic)
7. Vitamin C -- (Anti-Scorbutic)
8. Vitamin D -- (Anti-Rachitis)

The ash constituents have long been recognized as playing an important part in the growth of young animals, and of these, the elements most likely to be deficient are Calcium, Phosphorous, and Iron. Young animals are generally born with a reserve store of iron and when this reserve supply has been used the iron in the body will be found localized in the blood. A deficiency of iron becomes more noticeable in the blood than in other tissues, therefore, growth may not cease but the animal or young child may grow anemic. The Calcium is localized in the bones and over 99% of the Calcium is found there. An inadequate supply of Calcium in the food during growth retards the development and calcification of the bones.

Bone development may also be interfered with by the inadequacy of the Phosphorous supply. Several investigators in studying the effect of the diet upon the growth of the bone, have found that the bones formed in young animals kept on a diet poor in phosphorous and Calcium are apt to be soft, spongy and weak. This may be prevented by the addition of Calcium Phosphate to the food or Cod Liver Oil. There has been some argument as to the value of Cod

Liver Oil in poor Calcium and Phosphorous diet.

One experimenter found that if the development of bones is retarded by a low Calcium diet of average Phosphorous content that normal results could only be obtained by the addition of Calcium salts to the food and not by feeding Cod Liver Oil. Too much confidence has been put in the value of the Anti-Rachitic Vitamin and not enough care has been taken in providing a liberal supply of Calcium and Phosphorous during the period of growth and development.

Other investigators state that in the presence of Calcium and Phosphorous starvation, Cod Liver Oil enables the animal to get along as if the Calcium or Phosphorous were supplied in sufficient quantities in the diet. Cod Liver Oil not only acts as a regulator of Calcium and Phosphorous metabolism but also permits the organism to operate with greatly increased economy. In human rickets, the organism has lost the power to assimilate and hold the lime salts. Cod Liver Oil furnishes something to the body which enables it to assimilate and hold the lime salts. Cod Liver Oil makes the metabolic processes of the body, in respect to Calcium and Phosphorous more efficient. What Cod Liver Oil accomplishes in rickets is nothing more than the restoration of its power to make a successful adaptation to a faulty diet and a faulty environmental condition (room light).

The vitamins occur only in certain foods and are there in

only small amounts. The concentration of these vitamins is so low in foods that they have never been obtained in large enough amounts for scientists to determine their exact character. They have found, however, that they are indispensable to the diet. A young animal or young child will not be well nourished unless it gets the proper amount.

Of the vitamins, two, Vitamin A. and Vitamin B. are the growth promoting substances. If the animal receives the proper amount of protein, carbohydrates, fat, minerals, Vitamin C. and Vitamin D and Vitamin A and Vitamin B are absent or in insufficient quantities, normal growth is impossible. Of course, each individual food cannot contain each of the indispensable vitamins. The diet should contain the proper quota of each vitamin but the source of the vitamin is unimportant. We do not exclude such staple foods as white rice, potatoes, and white bread from our diet because of their deficiency in Vitamin A. The foods mentioned are satisfactory in the diet if the vitamins come from other sources.

Scientists have carried out experiments on various vitamins and investigated various foods as to their vitamin content and considered the study of Vitamin A quite important. Closely related to Vitamin A is Vitamin D, the Anti-Rachitic Vitamin. Milk, man's best food, contains each of the essential vitamins. The milk fat or butter contains Vitamin A.

Rats which have ceased or failed to grow on natural "protein-free milk" diets in which lard furnished the fat component, growth was resumed when butter-fat was substituted for lard. So butter-fat contains substances necessary for growth as well as maintenance.

Recent study of the anti-scorbutic value of cow's milk shows that it is less valuable than many raw fruits and vegetables. It takes large quantities of milk to prevent scurvy in guinea-pigs and to produce an improved rate of growth, which are readily secured by very small quantities of many dried green vegetables.

A few years ago experimenters became interested in whether or not a lack or insufficiency of the Anti-Scorbutic Vitamin in the diet would have any influence on the formation and maintenance of teeth in animals. Some of the earliest authors have looked upon the tooth as a fixed part of the body, in other words a dead substance, undergoing no change during the different pathological processes in the general organism. There was no reason to believe that the tooth should be any exception from other parts of the organism where an active metabolism is going on, so studies were made to see whether they found any chemical changes going on in the tooth during metabolic disturbances, as for instance in scurvy.

Experiments were tried on guinea-pigs and there was found in scorbutic guinea-pigs a decrease in Calcium and increase in Magnesium content. This substitution of Calcium by Magnesium is nature's attempt to keep up the amounts of salts in the teeth when she is in need of the Calcium. This is a pathological process and is classed under the term Osteomalacia. The high Magnesium content may also account for the very brittle condition of the teeth in scorbutic-fed guinea-pigs. Thus we see that a diet deficient in the Anti-Scorbutic

Vitamin is able to produce both histological and chemical changes in both the teeth and bones of animals.

The mineral metabolism, as affecting the concentrations of Phosphorous and of Calcium in the blood; the Anti-Rachitic Vitamin now known to exist in Cod Liver Oil, egg yolk, whole milk and other foods; and the ultra-violet rays of direct sunlight are all important factors in causation and prevention of rickets. Experimentally rickets can be produced by a diet of faulty mineral content, but usually only where there is a deficiency of the regulating factors- Anti-Rachitic Vitamin and Ultra-violet light.

Our present view is that rickets is a matter of nutritional deficiency which shows itself in a diminution of Calcium, or Phosphorous or both in blood serum, and can be prevented by maintenance of normal Calcium and Phosphorous content of blood serum whether this be accomplished by direct attention to the metabolism of Calcium and Phosphorous as such, or through the aid of the Anti-rachitic Vitamin or Ultra-violet rays.

Enough experimental work has been done to prove that vitamins are quite essential in the diet. Yet there is some doubt, however, as to the amount that is necessary in the diet to produce the best results.

- The purpose of the research undertaken as presented in this thesis is to show the effects of high and low vitamin contents in the diet as shown by experiments with white rats.

The rats were fed in their cages with an amount of
solid food, consisting of whole wheat bread, the rats were
about 100 grams each and when they were weighed they were
found to be about 100 grams.

The rats were weighed and placed in individual cages
and kept there for 24 hours. They were given all the food
of which composition is given in the table.

EXPERIMENTAL.

The rats were divided into two groups, one group consisting
of 10 rats and the other group consisting of 10 rats. Their weights were taken weekly
and all changes in appearance were noted.

The effect of various substances was studied in the three
groups of rats, 10 rats in each, and were fed on the following
diets:

Group 1

10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms
10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms
10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms

Group 2

10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms
10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms
10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms

Group 3

10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms
10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms
10 rats	100 gms	100 gms	100 gms	100 gms	100 gms	100 gms

EXPERIMENT NUMBER ONE.

The rats used in this experiment were one litter of Albino Rats, containing eleven individuals. The rats were about twenty-five days old when they were separated from their mother.

The rats were weighed and placed in individual sanitary cages when four weeks old. They were given all the food of their respective diets that they could eat.

The rats were all subjected to the same conditions of environment and temperature. Their weights were taken weekly and all changes in appearance were noted.

The litter of eleven subjects was divided into three groups of three, four, and four, and were fed on the following diets:

GROUP ONE

Rat #1-	Fresh Milk and White Bread Soaked in Water.
Rat #2-	" " " " " " " "
Rat #3-	" " " " " " " "

GROUP TWO

Rat #4-	Fresh Milk, Ice Cream and White Bread.
Rat #5-	" " " " " " " "
Rat #6-	" " " " " " " "
Rat #7-	" " " " " " " "

GROUP THREE

Rat #8-	Ice Cream, White Bread Soaked in Water.
Rat #9-	" " " " " " " "
Rat #10-	" " " " " " " "
Rat #11-	" " " " " " " "

The rats of Group II showed the best results.

The rats fed on bread and milk and bread and ice cream showed a steady increase but not as rapid gain in weight as the ones fed on bread, milk, and ice cream. The rats in Group II were perfectly healthy and their fur was white and soft.

The rats of Group III were not as active as of the other two groups--lack of protein (casein) due to lack of milk in their diets.

The weights of all rats fed on the same diet are given on the page following, and comparisons in rate of growth are made by means of a chart showing the best rat from each group.

GROUP ONE (CONTROL)

	Rat #1 Male	Rat #2 Female	Rat #3 Male
Sept. 15	34.4 gms.	23.6 gms.	30.3 gms.
" 22	46.4	35.6	45.5
" 29	66.9	57.2	69.5
Oct. 6	91.9	72.2	91.6
" 13	130.0	91.0	114.0

GROUP TWO (EXPERIMENTAL)

	Rat #4 Female	Rat #5 Male	Rat #6 Male	Rat #7 Male
Sept. 15	26.9 gms.	34.9 gms.	35.9 gms.	31.2 gms.
" 22	43.7	48.1	50.0	45.4
" 29	62.2	60.0	78.7	70.0
Oct. 6	85.2	82.3	108.9	103.6
" 13	104.5	105.0	130.0	130.0

GROUP THREE (EXPERIMENTAL)

	Rat #8 Female	Rat #9	Rat #10 Male	Rat #11
Sept. 15	26.9 gms.	31.2 gms	35.0 gms.	34.7 gms.
" 22	45.2		51.3	
" 29	60.5		69.7	
Oct. 6	71.2		87.1	
" 13	82.0		102.0	

Rats #9 and #11 got out of cages and could not be caught.

Chart # 1

EXPERIMENT NUMBER TWO.

The rats used in experiment two were one litter of Albino Rats containing seven individuals. This litter of rats was born Sept. 10th and they were separated from their mother at about the age of four weeks.

When they were four weeks and three days old they were separated and put in individual, sanitary cages and weighed weekly. They were given all of the food that they could eat.

The litter was divided into two groups of three and four and were fed on the following diets:

The Synthetic Diet used in these experiments contained:

Casein --	20%
Starch --	56%
* Salt Mixture	40%
Yeast --	5%

* The Salt Mixture was made up as follows:

Calcium Carbonate --	134.8 gms.
Magnesium Carbonate	24.2 "
Sodium Carbonate	34.2 "
Potassium Iodide	.020"
Potassium Carbonate	141.3 "
Sodium Phosphate	145.33 "
Sodium Chloride	86.03 "
Manganese Sulphate	.079"
Sodium Sulphate	133.35 "
Citric Acid	111.1 "
Iron Citrate	6.34 "
Potassium	
Aluminum Sulphate	.024"

The yeast was Fleischmann's Compressed Yeast dried in an air current at 100° C.

GROUP ONE

Rat # 12-	Synthetic Diet and Ice Cream.
Rat #13-	" " " " "
Rat #14-	" " " " "
Rat #15-	" " " " "

GROUP TWO

Rat #16-	Synthetic Diet and Cod Liver Oil.
Rat #17-	" " " " " "
Rat #18-	" " " " " "

The rats in Group One showed better results. Although there was a continued increase in weight, the growth was very slow. Their fur became slightly yellow.

The rats in Group Two gained very slightly. Their fur became yellow and stiff.

The weights of all the rats fed on the same diets are given on the page following, and comparison in rate of growth is made by means of a chart showing the best rat from each group.

GROUP ONE (EXPERIMENTAL)

	Rat #12 Male	Rat #13 Female	Rat #14 Female	Rat # 15 Male
Oct. 9	42.3 gms.	36.3 gms.	36.5 gms.	36.0 gms.
" 16	45.6	33.6	41.5	41.5
" 23	66.5	53.0	57.0	62.2
" 29	78.3	66.8	75.3	72.3
Nov. 5	86.6	68.3	86.9	79.9
" 13	82.2	69.0	84.3	79.5
" 19	80.6	73.6	84.4	84.4

GROUP TWO (EXPERIMENTAL)

	Rat #16 Male	Rat #17 Male	Rat #18 Female
Oct. 9	41.0 gms.	40.0 gms.	40.0 gms.
" 16	31.1	30.1	28.1
Died	Oct. 21	Oct. 20	Oct. 18

Three rats were taken from the litter born Sept. 28th and were fed the same diet as Group Two.

	Rat #19 Female	Rat #20 Male	Rat #21 Male
Oct. 21	21.5 gms.	22.5 gms.	22.9 gms.
" 29	23.6	24.5	24.8
Nov. 5	23.4	21.8	20.4
" 13	24.0	22.5	21.0
" 19	41.1		33.6
Died	Nov. 20	Nov. 15	Nov. 19

g-Rams

100

80

60

40

20

4

5

6

7

8

9

Weeks

— Rat #15 - Synthetic Diet + Ice Cream.

— Rat #19 - Synthetic Diet + Cod Liver Oil -

Died Nov. 20.

Chart #2.

EXPERIMENT NUMBER THREE

The rats used in Experiment Three were three litters of Albino Rats consisting of six, six and eight young. The rats were born Sept. 23th, Oct. 4th, and Oct. 5th.

At the age of three weeks the young were separated from their mother.

The rats were placed in individual, sanitary cages at the age of four weeks. They were subjected to the same conditions of environment and temperature. They were fed the same amount of their diet and their weights were taken weekly.

The three litters of rats were divided into five groups of four each and were fed on the following diets:

GROUP ONE

Rat #22-	Mazola Oil and Synthetic Diet (Outlined in Expt. Two)
Rat #23-	" " " " " " " "
Rat #24-	" " " " " " " "
Rat #25-	" " " " " " " "

GROUP TWO

Rat #26-	Cod Liver Oil, Synthetic Diet, and Ice Cream.
Rat #27-	" " " " " " " "
Rat #28-	" " " " " " " "
Rat #29-	" " " " " " " "

GROUP THREE

Rat #30-	Maasola Oil,	Synthetic Diet,	Ice Cream.
Rat #31-	" "	" "	" "
Rat #32-	" "	" "	" "
Rat #33-	" "	" "	" "

GROUP FOUR

Rat #34-	Ice Cream,	Carrots,	Synthetic Diet.
Rat #35-	" "	" "	" "
Rat #36-	" "	" "	" "
Rat #37-	" "	" "	" "

GROUP FIVE

Rat #38-	Ice Cream,	Whole Wheat Bread.
Rat #39-	" "	" "
Rat #40-	" "	" "
Rat #41-	" "	" "

Due to difficulty in maintaining a constant temperature the results were not as satisfactory as those that might have been obtained under normal conditions.

The weights of all rats fed on the same diets are given on the page following and comparisons in rate of growth are made by means of a chart showing best rat from each group.

GROUP ONE

		Rat #22 Male	Rat #23 Female	Rat #24 Male	Rat #25 Female
Nov.	2	24.5 gms.	17.0 gms.	25.0 gms.	17.2 gms.
"	13	Died Nov. 7	Died Nov. 8	31.6	Died Nov. 8
"	19			50.6	
"	29			61.7	
Dec.	4			72.3	
"	11			91.0	

GROUP TWO

		Rat #26 Male	Rat #27 Female	Rat #28 Male	Rat #29 Female
Nov.	2	29.5 gms.	17.9 gms.	25.0 gms.	20.2 gms.
"	13	39.0	25.0	23.5	19.1
"	19	50.6	38.0	Died Nov. 14th.	
"	29	60.0	50.8		
Dec.	4	74.0	64.3		
"	11	87.5	78.0		

GROUP THREE

		Rat #30 Male	Rat #31 Male	Rat #32 Female	Rat #33 Male
Nov.	2	26.0 gms.	17.5 gms.	25.5 gms.	18.9 gms.
"	13	Died Nov. 8	23.5	Died Nov. 8th.	
"	19		41.4		
"	29		53.2		
Dec.	4		65.8		
"	11		78.5		

GROUP FOUR

		Rat #34 Male	Rat #35 Female	Rat #36 Male	Rat #37 Female
Nov.	2	27.5 gms.	20.0 gms.	29.5 gms.	17.8 gms.
"	9	Died	Died	Died	Died

GROUP FIVE

		Rat #38 Male	Rat #39 Female	Rat #40 Male	Rat #41 Male
Nov.	2	31.5 gms.	24.0 gms.	31.8 gms.	25.1 gms.
"	13	52.5	45.0	50.5	45.3
"	19	60.6	57.1	63.6	60.6
"	20	Died	Died	Died	Died

Grams

100

75

50

25

4

5

6

7

8

9

weeks -

Died Nov. 20.

- Rat #26 - Cod liver Oil, Synthetic Diet + Ice Cream -
- Rat #31 - Mazola " " " " " "
- Rat #40 - Ice Cream + whole wheat Bread
- Rat #24 - Mazola Oil + Synthetic Diet -

Chart #3.

EXPERIMENT NUMBER FOUR

The rats used in Experiment Four were one litter of Albino rats born Nov. 25th containing eight young. One died when about seven days old. The remaining seven rats were separated from their mother at the age of thirty-five days.

When the rats were about forty-one days old, they were weighed and placed in individual, sanitary cages. The same amount of food was given them each day, being increased as they grew. Their weights were taken each week.

The litter consisting of seven subjects was divided into three groups of two, two, and three, which were fed on the following diets:

GROUP ONE

Rat # 42- Bread, Ice Cream, and 10cc Milk.
Rat # 43- " " " " " "

GROUP TWO

Rat #44- Bread, Synthetic Diet (Outlined in Expt. Two)
and Cod Liver Oil.
Rat #45- Bread, Synthetic Diet and Cod Liver Oil.

GROUP THREE

Rat #46- Bread, Synthetic Diet and Mazola Oil.
Rat #47- " " " " " "
Rat #48- " " " " " "

The rats on the regular diet showed a normal rate of growth and a steady increase in weight.

The rats in Group Two showed a slight increase in weight. At the end of the second week one rat died. Their fur did not remain white and soft but became dark and bristly. After two weeks, a small amount of ice cream was added to the diet and the rats became healthier and their fur became white and soft again. The feeding of the regular diet ascribed to Group Two with the addition of ice cream was continued. The rats showed a steady increase in weight.

The rats of Group Three showed a slight and steady increase in weight with the exception of the fifth week. They did not look healthy, although they were very active and spry. Their fur instead of being white and soft turned yellow and stiff and stringy. This was possibly due to the lack of vitamins and Calcium.

The weights of all rats fed on the same diets are given on the page following, and comparisons in the rate of growth are made by means of a chart showing the best rat from each group.

GROUP ONE (EXPERIMENTAL)

	Rat # 42 Male	Rat # 43 Male
Jan. 5	46.5 gms.	49.5 gms.
" 10	61.0	74.9
" 18	83.7	92.3
" 28	96.0	108.5
Feb. 4	107.5	120.5
" 14	107.5	120.5
" 18	121.5	121.5

GROUP TWO (EXPERIMENTAL)

	Rat # 44 Female	Rat # 45 Female
Jan. 5	44.5 gms.	44.5 gms.
" 10	57.5	57.5
" 18	71.7	Died Jan. 17th
" 28	88.5	
Feb. 4	96.5	
" 14	100.0	
" 18	105.5	

GROUP THREE (EXPERIMENTAL)

	Rat # 46 Male	Rat # 47 Male	Rat # 48 Female
Jan. 5	44.5 gms.	52.0 gms.	37.0 gms.
" 10	54.9	60.4	46.4
" 18	65.0	70.7	57.7
" 28	78.0	88.0	72.5
Feb. 4	83.0	92.0	77.0
" 14	83.0	92.0	77.5
" 18	88.5	100.5	84.5

Chart #4.

EXPERIMENT NUMBER FIVE.

The rats used in this experiment were three male rats about ten weeks old.

They were weighed and placed in individual sanitary cages. They were subjected to the same conditions of temperature and environment.

They were weighed weekly and given as much of their diets as they could eat.

They were separated into three groups of one each and fed on the following diets:

GROUP ONE

Rat #A- Bread, Milk, Ice Cream.

GROUP TWO

Rat #B- Bread, Ground Corn, Milk.

GROUP THREE

Rat #C- Bread, Ground Corn, Ice Cream.

The rat fed on a diet of Bread, Ground Corn and Milk showed a steady increase in weight and a rapid rate of growth.

The rat fed on the regular diet showed a steady increase in weight.

The rat fed on a diet of Bread, Ground Corn, and Ice Cream did not gain much. It became rather listless and only gained 19 gms. in six weeks. This diet is not good because of the lack of protein. Milk in the diet furnishes protein. Therefore, the diet of Group Two was better and showed better results.

The weights of all rats fed on the same diets are given on the page following:

GROUP ONE (CONTROL)

	Rat #A	
	Male	
Jan. 10	124.4 gms.	
" 18	142.2	
" 28	140.5	
Feb. 4	151.0	
" 14	163.0	
" 18	173.5	
" 25	187.3	

GROUP TWO (EXPERIMENTAL)

	Rat #B	
	Male	
Jan. 10	167.9 gms.	
" 18	181.0	
" 28	196.5	
Feb. 4	201.5	
" 14	207.0	
" 18	207.0	
" 25	212.0	

GROUP THREE (EXPERIMENTAL)

	Rat #C	
	Male	
Jan. 10	170.9 gms.	
" 18	165.7	
" 28	173.5	
Feb. 4	160.5	
" 14	171.0	
" 18	180.0	
" 25	189.5

----- Rat # B - Bread, Milk, Ground Coen
 _____ Rat # C - " , Ice Cream, "
 ----- Rat # A - Bread, Milk, Ice Cream

Chart # 5

EXPERIMENT NUMBER SIX

The rats used in this experiment were one litter of Albino Rats born Jan. 26th containing three individuals. The rats were separated from their mother at the age of 23 days.

When the rats were four weeks old they were weighed and placed in individual, sanitary cages. They were fed the same amount of diet and were weighed each week.

The litter consisting of three subjects was divided into two groups of one and two and were fed on the following diets:

GROUP ONE

Rat #I- Bread, Milk, Ice cream.

GROUP TWO

Rat #II- Bread, Milk, Ice Cream, Carrots.

Rat #III- " " " " "

There was very little difference as to the rate of growth of the two groups of rats. One rat in Group Two showed a greater gain in weight. This experiment shows that the control diet of bread, milk and ice cream gives good results and has substances necessary for good growth.

The weights of all rats fed on the same diets are given on the page following and comparisons in rate of growth are made by means of a chart showing the best rat in each group.

GROUP ONE (CONTROL)

Rat #I
Female

Feb. 23 51.9 gms.

Mch. 3 79.8

" 11 102.0

" 17 118.0

" 25 128.0

Apr. 1 149.0

GROUP TWO (EXPERIMENTAL)

Rat #II
Female

Rat #III
Male

Feb. 23 53.4 gms.

54.0 gms.

Mch. 3 73.5

76.0

" 11 92.5

96.5

" 17 110.0

115.0

" 25 120.0

138.0

Apr. 1 131.0

162.0

Grams -

200

150

100

50

4

5

6

7

8

9

Weeks

— Rat # I - Bread, Milk, Ice Cream
— Rat # III - Bread, Milk, Ice Cream + Carrots

Chart # 6.

EXPERIMENT NUMBER SEVEN

The rats used in Experiment Seven were one litter of Albino Rats consisting of three individuals. This litter of rats was born March 11th and at the age of three weeks were separated from their mother.

The rats were weighed and put in individual, sanitary cages. They were given all of the food that they could eat.

The litter of three was divided into groups of one and two and fed on the following diets. The grown rat that was fed on bread, milk, and ice cream in Experiment Six was used in this experiment and was fed the diet of Group One.

GROUP ONE

Rat #IV- Dried Milk (skim), Bread, and 5cc. of Milk(fresh)
Rat # V- " " " " " " " " "

GROUP TWO

Rat #VI- Dried Milk (skim), Bread, and Ice Cream.
Rat #VII- " " " " " " " "

There was very little difference in the results of the two groups. The rats of Group One showed a more rapid gain in weight.

The weights of all rats fed on the same diets are given on the page following and comparisons in rate of growth are made by means of a chart showing the best rat in each group.

GROUP ONE (EXPERIMENTAL).

		Rat #IV Male	Rat #V Male
April	4	41.5 gms.	150.0 gms.
"	11	58.5	160.5
"	18	78.5	173.0
"	25	110.0	180.0
May	2	126.0	194.0

GROUP TWO (EXPERIMENTAL).

		Rat #VI Female	Rat #VII Male
April	4	39.0 gms.	41.0 gms.
"	11	60.8	61.0
"	18	82.5	90.0
"	25	94.0	108.0
May	2	107.0	131.0

Chart # 7.

EXPERIMENT NUMBER EIGHT.

The rats used in Experiment Eight were six rats about two and one-half months old.

The rats were weighed and put in individual, sanitary cages. They were given all of the food that they could eat.

They were divided into two groups of three each and were fed on the following diets:

GROUP ONE

Rat #VIII-	Dried Milk (skim) and Water.
Rat #IX -	" " " " " "
Rat #X -	" " " " " "

GROUP TWO

Rat #XI -	Dried Milk (skim) and Ice Cream.
Rat #XII-	" " " " " "
Rat #XIII-	" " " " " "

The rats fed in Group One showed a rapid loss in weight and the ones that lived developed rickets at the end of three weeks. The rats of Group Two showed a loss in weight, but there were no signs of rickets. After three weeks two of the three rats died. The third rat was put on a regular diet and it gained weight rapidly.

The dried milk alone does not furnish enough of vitamins for growth and maintenance.

The weights of all rats fed on the same diets are given on the page following and comparisons in rate of growth are made by means of a chart showing the best rat in each group.

GROUP ONE (EXPERIMENTAL)

		Rat # VIII Male	Rat # IX Male	Rat # X Male
April 18		154.0 gms.	193.0 gms.	202.0 gms.
"	25	131.5	145.0	Died Apr. 20.
May	2	110.0	111.0	
"	6	Died	Died	

GROUP TWO (EXPERIMENTAL)

		Rat # XI Female	Rat # XII Male	Rat # XIII Female
April 18		153.0 gms.	211.0 gms.	131.5 gms.
"	25	157.0	210.0	133.0
May	2	144.3	170.5	121.0
"	9	133.5	Died May 6th.

— Rat #III - Dried Milk + Water
- - - Rat #II - " " + Ice Cream -

Chart # 8

EXPERIMENT NUMBER NINE.

The rats used in Experiment Nine were one litter of Albino Rats containing seven individuals. This litter of rats was born April 3rd and were separated from their mother at the age of three weeks.

They were weighed and put in individual, sanitary cages, and weights were taken weekly. They were given all of the diet they could eat also water to drink.

The litter was divided into two groups of two and two and were fed the following diets:

GROUP ONE

Rat #XIV- Dried Milk (skim), Fresh Milk, Small Amt. of Bread.
Rat #XV - " " " " " " " " " "

GROUP TWO

Rat #XVI- Dried Milk, Ice Cream, Small Amt. of Bread.
Rat #XVII- " " " " " " " " " "

The rats in Group One showed a more rapid rate of growth than those of Group Two.

The weights of all rats fed on the same diets are given on the page following and comparisons in rate of growth are made by means of a chart showing the best rat of each group.

GROUP ONE (EXPERIMENTAL)

		Rat # XIV Male	Rat # XV Male
April 25		42.0 gms.	37.5 gms.
May	2	53.5	52.5
"	9	60.5	Died
"	16	63.8	

GROUP TWO (EXPERIMENTAL)

		Rat # XVI Male	Rat # XVII Female
April 25		39.0 gms.	37.5 gms.
May	2	40.0	38.5
"	9	53.5	Died May 6th
"	16	56.5	

Grams

60

80

60

40

60

3

4

5

6

7

8

weeks -

— Rat # XIV - Dried milk, Fresh milk + Bread

— Rat # XIII - Dried milk, Ice Cream + Bread

Chart # 9.

The influence of A light and the response pattern in the
that is shown in the following way:

In the case of a light that is directed at the eye
a direct light will be given that shows that in a light that is directed
at the eye the eye will be a direct light in the eye and it
will be a direct light.

In the case of a light that is directed at the eye
CONCLUSIONS.
a direct light will be given that shows that in a light that is directed
at the eye the eye will be a direct light in the eye and it
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will be a direct light.

The influence of a high and low vitamin content in the diet is shown in the following ways:

1. The rats fed on a diet high in Vitamin A and B, showed a more rapid rate of growth than those fed on a diet low in Vitamin A and B. The fur of the rats fed on a diet high in Vitamin A and B was of unusual whiteness.

2. The rats fed on a diet high in Vitamin A and B showed a slow but continued increase in weight over the rats fed on a diet low in Vitamin B. The fur of the rats fed on a diet low in Vitamin B became yellow and stringy.

3. The rats fed on a diet high in Vitamin A and B exhibited unusual healthy, normal activity. Their fur was very soft and white. The rats fed on a diet low in Vitamin A showed a very slow gain in weight.

4. The rats fed on a diet high in Vitamin A and B were perfectly healthy and developed a long coat of fur of unusual whiteness. The rats fed on a diet low in Vitamin A made only a slight increase in weight. Their fur turned dark and bristly.

5. The rats fed on a diet high in Vitamin A and B were very active and showed a rapid gain in weight. Those fed on a diet low in Vitamin A and B were very listless, inactive and made a slow gain in weight.

6. The results obtained on the diets of Bread, Milk, and Ice Cream and Bread, Milk, Ice Cream, and Carrots showed that the diet of Bread, Milk, and Ice Cream was good enough to obtain normal results.

7. The rats fed on a diet high in Vitamin A made some increase in weight over the rats fed on a diet slightly lower in Vitamin A.

8. The rats fed on a diet low in Vitamin A and D lost rapidly in weight and the ones that lived developed rickets. The rats fed on a diet a little higher in Vitamin A and D lost weight but did not develop rickets.

9. The rats fed on a diet high in Vitamin A and B had a more rapid rate of growth than those fed on a diet low in Vitamin A.

In all cases where fresh milk was supplied in the diet, the rate of growth was more rapid. From all the experiments tried the diet which proved most satisfactory was that of Bread, Milk, and Ice Cream in which there was a high Vitamin content.

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