CLXXIII. FURTHER EXPERIMENTS ON THE INFLUENCE OF THE PARENTS' DIET UPON THE YOUNG.

I. THE INFLUENCE OF THE FATHER'S DIET.

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IN our previous experiments [Korenchevsky and Carr, 1923] we studied the influence of the father's diet before and after conception upon the number, weight and chemical composition of the young *at birth*. The results obtained showed that feeding the father before conception on a diet deficient in fat-soluble factor had no influence whatever on the young, either on their number or weight or the water, calcium, phosphorus and nitrogen content of their bodies.

In the present investigation we have tried to discover whether the father's diet before conception has any influence upon his productiveness and upon the vitality of the young and the calcification of their skeleton at the day of *weaning and later*.

Experiments were conducted in the following way on 36 females and 14 males. A group of adult females from the same litter were taken when about two to three months old and were fed on a normal diet *NB* (see composition below) for at least one month before the experiment began. The males were chosen from another litter, half of them were kept on a normal diet *N 2*, which was very rich in fat-soluble factor (see below) and contained ample calcium. The other half of the males were kept on the same *NB* diet as the females, containing butter only as the source of the fat-soluble factor and not cod-liver oil as is the case in diet *N 2* and also containing sufficient calcium although only half as much as is in diet *N 2*. For two weeks before conception the males, which had been kept on this *NB* diet, were fed instead with diet — *A*, deficient in fat-soluble factor. This was done to reduce the amount of fat-soluble factor in the body of the males without making them sterile. On the day they were mated, the females of each litter were divided into two groups, one group were put with the males on *N 2* diet, the other with the males on — *A* diet. In a few cases, females were taken from different litters for the two groups. The same proportion of females and males were mated in each group. One male was put with one to four females. Copulation occurred. After a few

days the males were segregated and the pregnant females were put in separate cages. During the whole of pregnancy the females were kept on the normal *NB* diet and during lactation on — *A* diet (deficient in fat-soluble factor). After birth all except five young from each litter were destroyed. Two of the young were killed on the day of weaning for chemical and histological examination of the skeleton. The other three continued to be kept on — *A* diet until they were 65 days old, when they were killed. The technique of the experiment was the same as described in previous papers [Korenchevsky, 1921, 1922]. Here we will only give the composition of the diets used.

All the diets have the following basal formula:

Purified casein	...	18 g.	Orange juice	...	...	...	8 cc.
Starch	...	52 g.	Distilled water	...	...	...	50 cc.
Fat	...	15 g.	McCollum's (1917) salt mixture				5 g.
Dried yeast	...	5 g.					

The variations in the diets are clear from Table I.

Table I.

Diets	Kind of fat used in the diet	Amount of calcium %		Remarks
		In fresh paste	In air-dried paste	
<i>NB</i>	Butter	0.26	0.4	Normal diet, containing an adequate, but not excessive amount of calcium and fat-soluble factor
<i>N 2</i>	80 % butter + 20 % cod-liver oil	0.52	0.8	Normal diet, rich in fat-soluble factor and calcium
— <i>A</i>	Cotton-seed oil	0.26	0.4	Diet with an adequate amount of calcium, but deficient in fat-soluble factor

The results of these experiments were as follows:

A. In the group containing fathers on *N 2* diet (above) before and during mating (mothers fed on *NB* diet before and during pregnancy and — *A* diet during lactation):

1. From the 24 matings no pregnancy ensued in one case (4.2 %).
2. Of the 23 litters born three were eaten (13.0 %).
3. Out of 75 young left in 15 litters and studied in this group 10 died (13.3 %) before the end of the experiment from different morbid causes (diarrhoea, accidental infections and general weakness).
4. The average weight of a young rat at the day of weaning (24 days old) was 31 g. for male and 29 g. for female; when 65 days old 62 g. and 51 g. respectively.

B. In the group containing fathers on — *A* diet for two weeks before mating (mothers fed on *NB* diet before and during pregnancy and — *A* diet during lactation):

1. From 34 matings no pregnancy ensued in eight cases (23.2 %).

2. Of the 26 litters born 11 were eaten (42.3 %).

3. Out of 70 young left in 14 litters and studied in this group, 13 died (18.6 %) before the end of the experiment from the different morbid causes mentioned above.

4. The average weight of a young rat at the day of weaning (24 days old) was 31 g. for male and 30 g. for female; when 65 days old 61 g. and 55 g. respectively.

The results of the chemical investigation of the skeleton of the young kept on a rickets-producing — A diet are clear from Tables II and III.

Table II. *Average chemical composition of the skeleton of the young rats kept on a fat-soluble factor deficient — A diet, whose fathers were fed on a diet rich in fat-soluble factor and calcium (N 2).*

Experiment no.	Killed when 24 days old In bones			Killed when 65 days old In bones		
	H ₂ O %	Fresh Ca %	Dry Ca %	H ₂ O %	Fresh Ca %	Dry Ca %
1	62.4	4.7	12.5	60.0	5.6	13.9
2	60.0	4.8	12.0	—	—	—
3	58.2	4.8	11.5	—	—	—
4	59.3	4.9	11.8	49.2	6.4	12.5
5	61.8	4.9	12.8	55.1	6.0	13.3
6	62.9	4.9	13.3	55.2	5.2	12.4
7	61.7	4.9	12.7	51.1	7.0	14.2
8	63.6	5.0	13.7	48.0	6.7	12.8
9	58.4	5.0	12.1	52.0	6.6	13.8
10	62.3	5.2	13.8	46.3	6.3	11.8
11	56.9	5.3	12.2	54.1	6.0	13.3
12	63.0	5.3	14.2	49.8	7.8	15.5
13	58.7	5.4	13.0	46.8	6.9	13.0
14	61.1	5.4	13.8	47.5	8.8	16.8
15	58.2	5.7	13.5	45.1	8.0	14.5
Average	60.6	5.1	12.9	50.8	6.7	13.7

Table III. *Average chemical composition of the skeleton of young rats kept on a fat-soluble factor deficient — A diet, whose fathers were fed on — A diet poor in fat-soluble factor.*

Experiment no.	Killed when 24 days old In bones			Killed when 65 days old In bones		
	H ₂ O %	Fresh Ca %	Dry Ca %	H ₂ O %	Fresh Ca %	Dry Ca %
16	66.4	3.7	11.0	—	—	—
17	62.7	4.5	11.9	50.9	7.1	14.3
18	59.3	4.6	11.4	—	—	—
19	61.4	4.7	12.1	52.7	6.5	13.7
20	63.4	4.7	12.8	—	—	—
21	60.7	4.8	12.3	51.5	7.0	14.4
22	60.1	4.8	12.0	—	—	—
23	62.2	4.9	13.0	49.7	6.8	13.5
24	61.2	5.0	12.9	—	—	—
25	61.3	5.1	13.1	49.4	5.9	11.7
26	59.4	5.1	12.5	48.7	7.5	14.7
27	59.3	5.1	12.4	—	—	—
28	62.3	5.2	13.4	51.5	7.4	15.3
29	61.4	5.4	13.9	53.8	6.4	13.7
Average	62.2	4.8	12.4	51.0	6.8	13.9

The figures represent an average from each litter of the analyses of the skeletons of two young rats at the day of weaning and of three young rats when 65 days old, if all the rats lived till the end of the experiment. If they did not all survive, averages were made from the decreased number of young rats in each litter which lived till killed for examination. The results are summarised only in general average tables, because no constant or definite difference was found between the calcification of the skeleton of the young begotten by fathers on a good diet and those begotten by fathers on a deficient diet. The average figures (see Tables II and III) are nearly the same in both groups and in most cases are within the usual fluctuations found in the calcification of the skeleton of rats kept on this fat-soluble factor deficient diet.

However, the skeleton in three litters, Nos. 12, 14 and in most of 15, begotten by fathers kept on *N* 2 diet (cod-liver oil), showed an unusually good chemical composition, especially in those rats killed when 65 days old (Table II). But as this change was found in three litters only and because there was no definite difference in the average figures of Tables II and III, no special significance can be ascribed to this increase in the calcification of the skeleton in the above-mentioned litters.

Histological investigation of the skeleton was made only in nine litters altogether, because no differences had been found in the chemical composition. Picture of osteoporosis with slight rickets prevailed. In correspondence with the chemical results there were no essential histological differences between the groups.

It is of interest to mention here the results of a careful investigation by Dr Ougrumov [see Korenchevsky, 1914], because he came to conclusions which showed the importance of the father's nutrition before conception. Ougrumov made his experiments with rabbits. He mated normally fed females with males which had been starved for varying lengths of time. Litters conceived under these conditions, even though born from normal females, possessed much less vitality: they were so weak that they very often died a few minutes after birth. A chemical investigation of these young rabbits just after birth showed that their bodies contained more water and fat and less nitrogen and calcium than those begotten by normally fed fathers.

SUMMARY.

In our few experiments it was found that:

1. If the diet of the males before conception was deficient in fat-soluble factor, a greater percentage of matings was unproductive.
2. The litters, begotten by fathers kept on a diet deficient in fat-soluble factor, seemed to be weaker: in our 49 successful matings a greater percentage of these litters were eaten by the mothers, and more young died from accidental diseases than amongst those begotten by richly-fed fathers.
3. No difference was noticed in the weight of the young in the two groups nor in the calcium composition of their skeletons.

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