XXVI. THE VITAMIN B CONTENT OF GRASS SEEDS IN RELATIONSHIP TO MANURES.

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Since carrying out this work we have noted that Colonel McCarrison in 1924 published in the *British Medical Journal* his results on the effect of "artificial" and also cattle manure on the nutritional value of certain grasses. We have also found that G. H. Hunt at Ohio Agricultural Experiment Station in December 1927 performed certain experiments on the effect of what we now call artificial manures on certain wheat plots. We were unaware of this work until a few weeks ago, but we note that our work confirms McCarrison's.

This research was undertaken because one of us (M.J.R.) had noticed that pigs which were fed on home grown and home ground barley and wheat always did much better than those pigs which were fed on purchased barley and wheat, and that certain cattle did better on certain fields. It was decided to find out whether this was due to the lack of lime or of other mineral constituents of the land. The results of this investigation were not satisfactory. It was then decided to try the effect of artificial manure versus dung. In this experiment pigs' excreta mixed with straw were used. These pigs were fed on a diet consisting of 10 % of a proprietary product (containing meat meal, rye and wheat embryo which is high in its vitamin B content, bone meal and cod-liver oil), 40 % of barley meal, and 50 % of middlings.

Two areas of land were pegged out in the same field, on the same side so that both had the same amount of sunlight. The drainage was equal from both areas. This field had previously been an arable one and had grown cabbages in the fifth year before this experiment was carried out, and in the fourth, potatoes. It was then ploughed up and sown with seeds which were made up to contain a small quantity of the different clovers. These seeds were sown with a nurse crop of wheat in 1927, the wheat having been sown in the previous year, 1926. In 1927 the seeds were cut at the time when the wheat was reaped. The field was lightly fed in the autumn of 1927. In 1928 it was cut for hay and grass. In the autumn of 1928 one portion of the land was dunged at the rate of 20 loads of dung to the acre, which is the usual dressing used by the farmer. The other portion was manured with artificial manure, 20 cwt. basic slag plus 3 cwt. kainite to the acre, and in the spring

of 1929, 1 cwt. of sulphate of ammonia was applied as a top dressing. In July 1929, these areas were cut by hand and were gathered as soon as dried and placed in separate barns. There was undoubtedly a bigger growth in the dunged area, but not so weighty as that in the artificially manured area. There was more clover in the artificially manured patch. This is what would be expected as the result of manuring with the basic slag. The analysis of the grass seeds showed little difference:

	Protein	Moisture	Fibre	Ash	Phosphorus
	%	%	%	%	%
"Dung" grass seed	12·7	5·8	19·4	9·0	0·44
"Artificial" grass seed	11·7	6·0	21·6	10·5	0·33

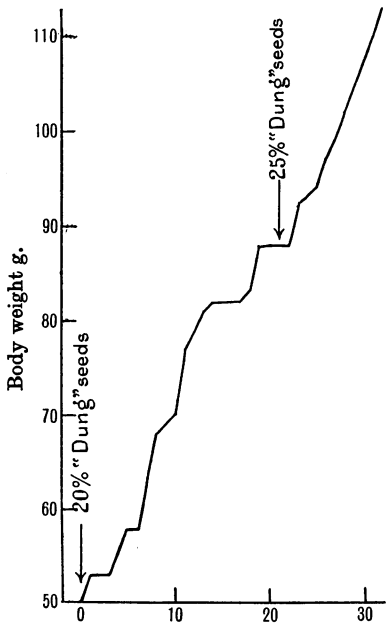

Fig. 1. Rat $\eta\omega$ (δ).

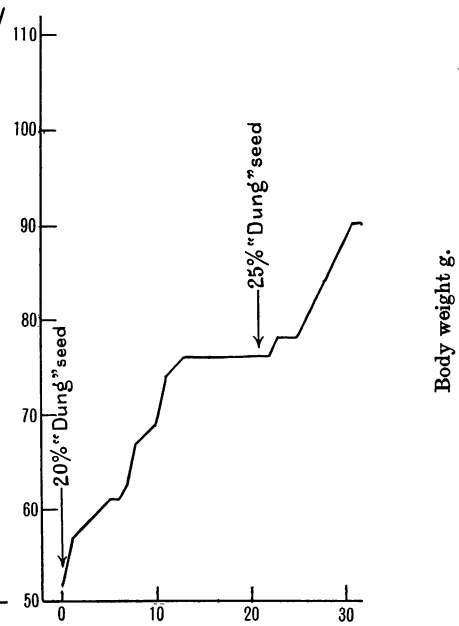

Fig. 2. Rat $\eta\omega$ (δ).

It was evident that grass seeds with such a large fibre percentage were not an ideal diet for the rat, but we decided to test their vitamin B content.

The University College vitamin B deficiency diet of Prof. Drummond was used—rice starch, caseinogen, salt mixture and cod-liver oil. To this were added varying percentages of the grass seeds. Two groups of experiments were carried out, preventive and curative.

In the preventive test, the rats were divided into two lots; one lot was put on deficiency diet to which was added 20 % of the "dung" seed, the other on deficiency diet with 20 % of the "artificial" seed. After 21 days the percentage of seeds was increased to 25 for a further 11 days. The rats on the "dung" seed showed good growth or a slightly subnormal growth. Figs. 1 and 2 are examples of these two types. The rats on the "artificial"

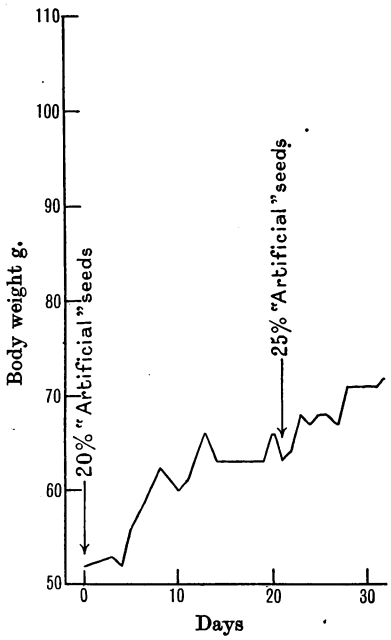

Fig. 3. Rat $\delta\gamma$ (♂).

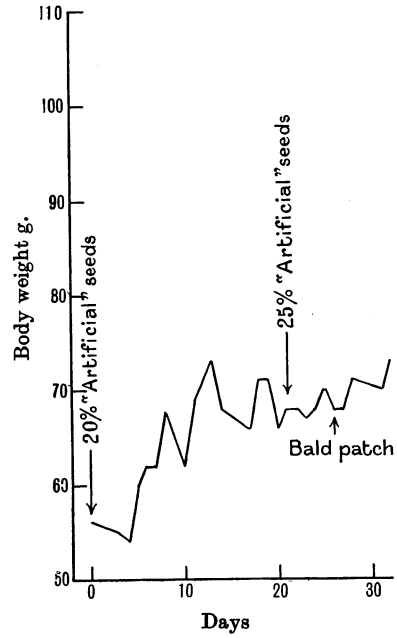

Fig. 4. Rat $\delta\pi$ (♂).

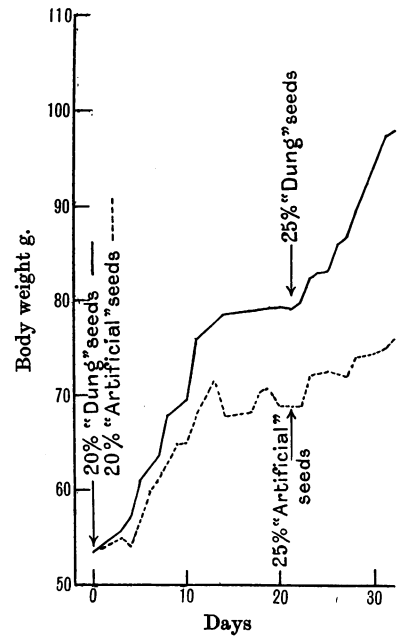

Fig. 5. Rats ηs and δs (♂).

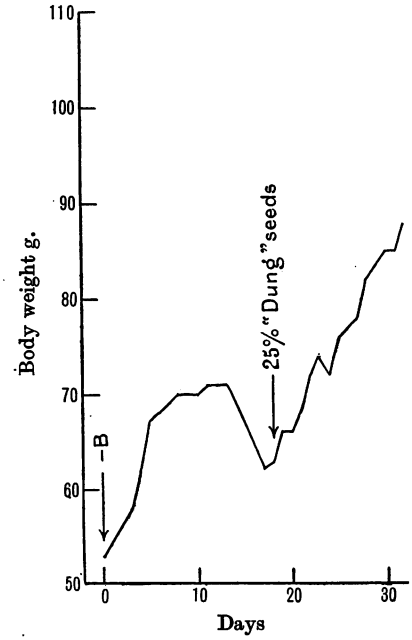

Fig. 6. Rat $\beta\gamma$ (♂).

seeds all grew very poorly, not one giving normal growth. Figs. 3 and 4 illustrate two of these rats. The average growths of the two sets of rats are shown in Fig. 5, the continuous line representing the "dung" seed rats, the broken line the "artificial" seed ones. It can be seen that the former have gained nearly twice as much as the latter, 45 as against 23. The rats on the "artificial" seed were in a poor condition; in some the hair was falling out.

In the curative test rats were put on a vitamin B deficiency diet for 18 days, when all were losing weight. Half of them then had 25 % of "dung" seeds added to their diet and immediately resumed a normal growth curve (Figs. 6, 7, 7 *a*). The other half had 25 % of "artificial" seeds added to their

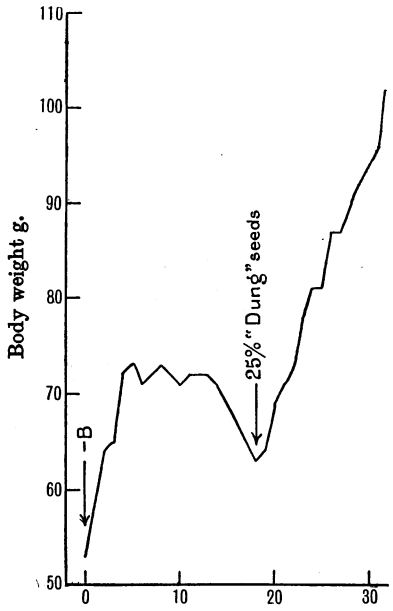

Fig. 7. Rat $\beta\omega$ (♂).

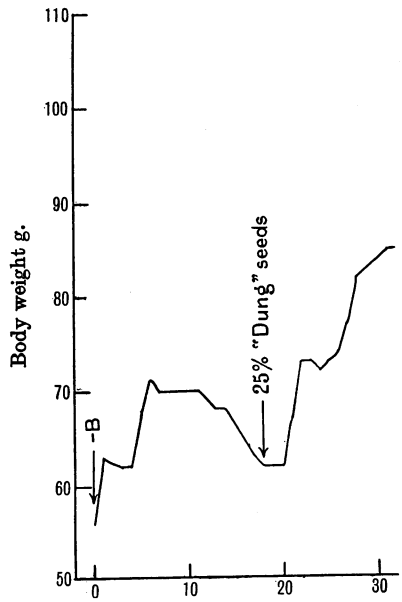

Fig. 7 *a*. Rat $\beta\pi$ (♂).

diet. Their condition did not improve but got steadily worse, so that after 3 days it appeared that some of the animals would not live more than a few hours. Their condition was one of typical vitamin B deficiency; they were wasted, hunched and shedding hair. At the suggestion of Prof. Drummond who saw the animals at this time the diet was changed from "artificial" to "dung" seeds. The immediate result was that the rats rapidly recovered, and now showed a normal growth curve (Figs. 8, 9, 9 *a*).

It would seem that a plant may absorb vitamin B from the land, and that the vitamin B content of any food may be dependent upon the amount of this vitamin in the land. Possibly the view that vitamin B is manufactured entirely in the plant and stored in the embryo is incorrect, and our suggestion would account for the variations in the results of tests carried out by different

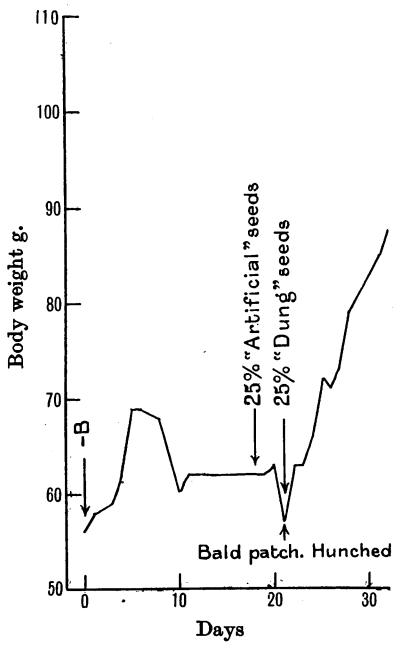

Fig. 8. Rat $a\omega$ (♂).

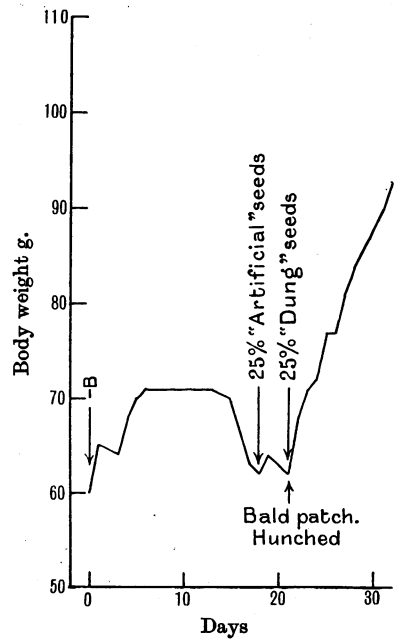

Fig. 9. Rat $a\gamma$ (♂).

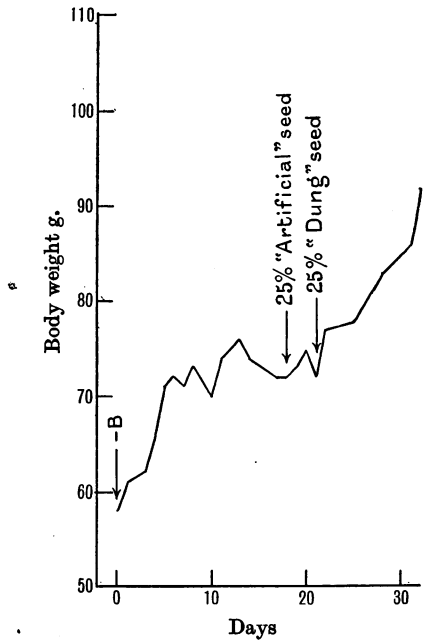

Fig. 9 *a*. Rat $a\pi$ (♂).

workers. One worker states that in his experimental work a certain food contains vitamin B; another worker using the same type of food differs entirely in his findings, and we consider that the food that is being tested is not the only point which is of importance. If these results are correct, they have a considerable bearing upon agriculture and nutrition.

Further research along these lines is being carried out and the faeces of pigs fed on the above experimental diet are being tested for the presence of vitamin B.

(*Note added January 27th, 1930.*) Since sending this paper for publication, dung from pigs has been tested for its vitamin B content. The pigs were fed on the diet described at the beginning of the paper. An extract was made from the dung with slightly acidified 50 % alcohol. This was concentrated by distilling *in vacuo*, and the concentrate fed to rats that were losing weight on vitamin B deficiency diet. Good growth was promptly begun, showing that there is a considerable quantity of vitamin B in the dung.