protein content of wheat correspond with the length of the period of the different deferred applications of nitrate made after planting, this would indicate a significant relation between the state of development of the plant and when nitrate can be most effectively utilized by the plant in the production of high protein wheat. This emphasizes that the physiological status of the plant, as indicated in its different growth phases, is a factor of great importance in the utilization of plant food available to it.

Not only was the protein content of the wheat increased by all of the deferred applications of nitrogen, but the yield of produce, excepting that obtained by the latest application, was much larger from the plants that received nitrogen for the period of 33 to 72 days after planting than those that received nitrogen during the early growing period. The best quality wheat as determined by commercial grading was secured from the plants that received nitrogen 72 and 110 days after planting. This means that the high protein wheat berry was likewise plump and well filled.

A much fuller account of the investigation with ample analytical data and a critical review of other investigations relating to the subject will shortly appear. It is felt that the results obtained in this investigation do show that the low protein content of Pacific states wheats is not due primarily to the climate as such, but so far as the investigation with this one soil is concerned, is due to insufficiency of available nitrogen at certain growth periods of the plants. That climate is not without effect upon the availability of the plant food in the soil is obvious, but the emphasis to be laid on the climatic complex is that it affects the nutrition of the plant. This can be both in the kind and quantity of each of the different nutrients that may be available to it. That this availability is an important factor in affecting the composition of plant products is shown by the results of this investigation.

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THE VITAMINE REQUIREMENTS OF THE RAT ON DIETS RICH IN PROTEIN, CARBOHYDRATE, AND FAT RESPECTIVELY[1]

IN 1913, one of us (C.F.) showed that the onset of the symptoms of beriberi in pigeons could be hastened by increasing the amount of polished rice fed. This led to the conclusion that the anti-beriberi vitamine—vitamine B—plays an important rôle in carbohydrate metabolism. This observation was confirmed shortly afterwards by Braddon and Cooper and others, although Eijkman and Vedder have denied the validity of this finding.

In a second series of experiments, in which the diets varied as shown in Table I., it will be noticed that beriberi developed in the following order: starch, sugar, casein, and fat.

TABLE I

Diet	Starch, Per Cent.	Sugar, Per Cent.	Casein, Per Cent.	Fat, Per Cent.	Salts, Per Cent.	Onset of Beriberi, Days
Starch ...	60	12	12	12	4	24
Sugar....	12	60	12	12	4	28
Casein...	12	12	60	12	4	30
Fat.....	12	12	12	60	4	40

In order to check up the results obtained with pigeons in another class of animals, and also with the idea of attempting to throw some light on the prevailing view as to the importance of proteins of high biological value on the etiology of pellagra and war edema, analogous experiments have been carried out on rats. The composition of the diets and the results obtained are shown in Tables II. and III.

TABLE II

Diet[2]	Meat, Gm.	Sugar, Gm.	Starch, Gm.	Lard, Gm.	Salts, Gm.	Autolysed Yeast, Cc.	Orange, Cc.	Agar, Gm.	Cod-liver Oil, Cc.
Meat	49	12	12	12	3	4	3	3	5
Sugar	12	49	12	12	3	4	3	3	5
Starch	12	12	49	12	3	4	3	3	5
Lard.....	12	12	12	49	3	4	3	3	5

[1] From the Research Laboratory of H. A. Metz.

[2] The meat, sugar, starch, and lard were tested and found to be free from Vitamine B.

TABLE III

Diet	Weight—First 25 Days		Weight—Following 55 Days		Total Weight Increase, Per Cent.[3]
	Increase, Per Cent.	Decrease, Per Cent.	Increase, Per Cent.	Decrease, Per Cent.	
Meat	43	–	86	–	129
Sugar	15	–	55	–	70
Sugar and vitamine[4]	15	–	145	–	160
Starch	6	–	62	–	68
Starch and vitamine[4]	6	–	165	–	171
Lard	–	9	—	8	−17
Lard and vitamine[4]	–	9	34	–	25

The rats on the protein diet did not require the addition of extra vitamine (autolyzed yeast) at all. This may be regarded as the "sparing action of protein on the vitamine requirement." On the other hand, the rats on the fat diet took the extra vitamine with great avidity, but showed only a small advantage over the controls. The replacement of some of the fat by butter was without any significance, no improvement being noted.

On the starch diet, the rats actually needed extra vitamine (about 2 c.c. per day) in order to resume growth. This was likewise true of the rats on the sugar diet except that they appeared not to require as much vitamine for growth as those on the starch diet. On these diets we occasionally observed sudden large increases and losses in weight, suggestive of edema, though no external evidence was seen. As regards the general appearance of the animals, those on the protein diet and those getting extra vitamine looked very healthy, while the others appeared to be in poor shape with the usual evidences of improper nutrition. The rats on the high fat diet, without extra vitamine, presented the poorest appearance.

Out of thirty rats, only one developed keratomalacia, and this rat was getting five per cent. cod-liver oil. The eye condition cleared up on giving autolyzed yeast (about 2 c.c. per day).

[3] In this instance, the figure represents the increase after 60 days, and is practically the same after 80 days, since most of the animals had already attained full size.

[4] Vitamine given during last 55 days.

The findings reported here show conclusively that although the qualitative food requirements of a well balanced diet have been pretty well established, this can not be said of the quantitative relationship between the dietary constituents necessary for proper nutrition. It is quite conceivable that under the abnormal conditions existing durng the war period and after, the usual ratio between the protein, carbohydrate, and vitamine constituents have been so changed as to present conditions analogous to those described by us in rats.

Theoretically at least, the above conditions could be corrected in either of two ways—(*a*) by increasing the protein and decreasing the carbohydrate intake, or (*b*) by supplying extra vitamine. The curative experiments of edema in rats reported by Miss Kohmann, and also the condition described as pellagra in a monkey, by Miss Chick, may be viewed in the above light. In view of the complications presented by the "sparing action of animal protein on the vitamine requirements," it may be just as well for the present to leave the question open, as to whether or not pellagra and war edema are avitaminoses. Of all the theories regarding pellagra, that expressed by Goldberger in which he states the facts and leaves the matter open for further investigation, appears to us to be the most satisfactory.

Our complete results will be published in detail later on.

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