min.), suggesting, we believe, that other factors vary to compensate for any prothrombin deficiency which may exist. In one case, not listed in the table, the new test consistently gave normal values, whereas the 2-stage titration showed that the prothrombin was, in reality, 50% of normal. Since thromboplastin is eliminated as a variable by the test, it follows that some other factor varied, permitting thrombin to be formed with normal speed[5] despite a deficiency in prothrombin. In most cases, however, the new test, by eliminating thromboplastin variations, gives values corresponding to the true prothrombin level. This suggests that thromboplastin itself may vary in amount, effecting compensation.

The new test, like the "prothrombin test" of Quick,[3] measures not prothrombin alone, but the summation of several variables, and it thus supplies a practical measure of the tendency to bleed. It is a simplification of his test, in that thromboplastin is added directly to whole blood instead of to plasma. This eliminates centrifugalization, recalcification, and titration. It is a bedside test which we have found to be useful as a guide for vitamin K therapy.

10506 P

Effect of Riboflavin-low Diets upon Nerves, Growth, and Reproduction in the Rat.*

R. W. ENGEL AND P. H. PHILLIPS. (Introduced by E. B. Hart.)

From the Department of Biochemistry, College of Agriculture, University of Wisconsin, Madison.

While investigating the nervous system of growing chicks maintained on a riboflavin-low diet (Phillips and Engel[1, 2]) it was discovered that severe degeneration occurred in the myelin sheaths of the spinal cords and the peripheral nerves. The purpose of this study was to determine whether similar nervous system changes would occur in the rat raised under similar dietary conditions.

[5] Warner, E. D., Brinkhous, K. M., and Smith, H. P., PROC. SOC. EXP. BIOL. AND MED., 1939, **40**, 197.

* Published with the approval of the Director of the Wisconsin Agricultural Experiment Station. These studies were aided in part by the Works Progress Administration. Supported in part by a grant from the Wisconsin Alumni Research Foundation.

[1] Phillips, P. H., and Engel, R. W., *Poul. Sci.*, 1938, **17**, 463.

[2] Phillips, P. H., and Engel, R. W., *J. Nutr.*, 1938, **16**, 451.

The basal ration used in the chick studies consisted of:

Yellow corn	59	NaCl	1
EtOH extracted casein	12	$Ca_3(PO_4)_2$	1
Wheat bran	5	$CaCO_3$	1
Whole wheat	20	Cod liver oil	1

The riboflavin content of this ration was further reduced in this study by replacing 40% of the yellow corn with dextrin and by using a purified casein washed and reprecipitated 4 times.

Two normal adult female albino rats were maintained on this ration for a period of 5 months, one of them receiving a supplement of 25 mg of nicotinic acid per kilo of ration. During this experimental period each female bore and reared 3 litters of young. The mothers maintained their original weight over the 5-month period and no deficiency symptoms became apparent. The pups were normal in size and appearance, and numbered from 6 to 11 per litter. Twelve pups were autopsied during the suckling period; 16 were weaned at 3 weeks of age and fed the deficient ration which their mothers were receiving. Twelve of these were removed for histologic study between 3 and 5 weeks of age. The remaining 4 were fed the basal diet and allowed to grow to maturity. Two of these were given the basal ration plus nicotinic acid at the rate of 25 mg per kg. These 4 animals grew at the rate of only 12 g per week but they did not develop nervous symptoms. This would indicate that the ration was sufficient in riboflavin but lacking a growth factor or factors for the rat, and that nicotinic acid did not improve the ration.

A total of 24 animals were thus autopsied at ages ranging from 1 day to 5 weeks. Routine examination of the spinal cord and peripheral nerves by methods previously described (Engel and Phillips[3]) revealed normal nerve structure. Brain, liver, and kidney, stained with H and E were examined and found to be normal except for occasional cases of vacuolization in the liver parenchyma.

Summary and Conclusions. 1. The severe nerve degeneration characteristic of growing chicks fed a riboflavin-low ration failed to occur in rats maintained on a similar ration. 2. A ration low in riboflavin for the chick had no adverse effect upon reproduction in the rat. 3. This ration apparently lacks a growth-promoting factor for the rat. The addition of nicotinic acid did not improve the ration.

[3] Engel, R. W., and Phillips, P. H., *J. Nutr.*, 1938, **16**, 585.