The structure of bone marrow is adapted to the maintenance of an erythroid-myeloid ratio, the regulation of the proportion of the stages of maturation of both red and white strains, and the delivery of cells to the blood. The regulation of these factors is in part vascular and in part chemical. With red cells developing in collapsed capillaries, and white cells developing extravascularly near dilated sinuses, the mechanism that controls the proportion of collapsed to dilated sinuses regulates in part the erythroid-myeloid ratio. The chemical forces that act on the marrow cells, as distinct from those that act on the endothelium, are divided into two activities: chemotactic factors (C) that attract the cells into the blood, and growth-stimulating, or maturation (M) factors for both red and white strains. Certain chemotactic factors for the white cells are known—bacterial proteids and the physiological product, nucleic acid. A maturation factor for red cells has been discovered by Minot and Murphy[1, 2] in liver.

[1] Minot, G. R., and Murphy, W. P., *J. Am. Med. Assn.*, 1926, lxxxvii, 470.

[2] Murphy, W. P., and Minot, G. R., *Boston Med. and Surg. J.*, 1926, clxxxxv, 410.

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Vitamin B Testing Revised.

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The demonstration by Smith and Hendrick,[1] Goldberger and coworkers,[2] and others[3] in this country that what we have called vitamin B is composed of at least two factors, each with specific functions and properties, necessitates the revision of existing vitamin B tests. In England, Chick and Roscoe[4] have been able to confirm the contentions of Goldberger. They showed that wheat embryo is distinctly richer in antineuritic factor than in antipellagric factor, by utilizing autoclaved yeast as the source of antipellagric and a preparation of Peters to supply the antineuritic. The Peters' fraction was separated by Kinnersley and Peters[5] of Oxford University by controlling the selective adsorption of norite. During the past year Williams and Waterman of our laboratory have also succeeded in separating a yeast fraction which is antineuritic, but is apparently

free of the factor (antipellagric) which is present in autoclaved yeast. Their separation was attained by controlling the selective adsorption of fuller's earth.[6]

In contrast to the alcoholic extract of corn meal used by Goldberger, Williams' preparation has supplied a testing fraction entirely devoid of antipellagric factor. To date we have been able to use this preparation in retesting two sources of vitamin B.

Last year we reported that ripe banana tested by the Sherman method must be supplied to rats on B-free, but otherwise adequate diet, in quantities of 8 to 10 gm. daily, to permit a growth gain of 20 gm. in 60 days. Using 5 mg. daily of the Williams' preparation as adequate source of antineuritic, we find that 2 gm. of banana daily supplies enough antipellagric factor to produce 20 gm. gain in 60 days, and that 6 gm. daily is nearly adequate for normal growth. By using autoclaved yeast as antipellagric, we find that at least 6 gm. of banana daily must be added to prevent growth decline. In brief, the banana is at least three times as rich in antipellagric factor as in antineuritic, though both are present.

Osborne and Mendel[7] reported that 1 gm. of dried fresh spinach would support normal rat growth when used as a sole source of vitamin B in an otherwise adequate diet. Kohman aand Eddy[8] confirmed this result in more recent tests. We found that rats would not eat enough of dried canned or cooked spinach to accomplish this effect but would eat it and grow normally if 1/3 of their total B requirement was met by dried yeast. At the time these tests were made Williams was unable to protect pigeons from polyneuritis with a dosage of 4.4 gm. dried canned spinach, and this observation was noted in our report at the time. At the time also we interpreted our yeast-spinach results as a matter of appetite stimulation rather than absence of the vitamin in the canned product.

We have recently repeated tests on cooked spinach with the aid of the Williams' preparations and autoclaved yeast. Home cooked, fresh spinach is about 98% water. However, when the rat's antineuritic requirement is met by 5 mg. daily of Williams' preparation, 2 gm. daily of the undried cooked spinach supplies enough antipellagric to produce nearly normal growth in test animals. This amount fails to supply enough of both factors to prevent growth decline, but when combined with 0.5 gm. daily of autoclaved yeast it will prevent such weight decline. Cooked fresh spinach, therefore, contains some antineuritic factor, but like the banana is richer in antipellagric than in antineuritic. The quantitative distribution of the two factors in dried fresh spinach, cooked and canned spinach, awaits further tests.

These two preliminary studies indicate the possibility of quantitative revision of our vitamin B tables, through use of the Peters' or the Williams' preparations. The study of Williams' preparation in bird tests has shown, however, that while antineuritic for these animals and capable of checking weight decline, it is not able to restore them to normal weight. Autoclaved yeast also fails to provide the restorative for birds though effective in rats. Finally yeast or whole grains prove both antineuritic and restorative of weight for pigeons. As Williams and Waterman have pointed out, these factors appear to indicate that yeast and whole grains contain a B factor which is not antineuritic, not present in autoclaved yeast and necessary to bird weight control. Our tests on Peters' fraction are not yet sufficiently advanced to state whether his fraction is like Williams' or different, but in the only two observations reported by Peters it failed to prevent weight decline in pigeons.

The doubts raised by the above tests as to whether vitamin B is dual or still more multiple in nature, are obvious, and suggest further study of the vitamin B fractionation before attempting extensive revision of the existing tables. Tools are, however, now available for assaying at least two of these factors with the rat as test animal.

[1] Smith and Hendrick, Public Health Report, U. S. P. H., 1926, xli, 201.

[2] Goldberger and coworkers, Public Health Reports, U. S. P. H., 1926, xli, 297, and U. S. P. H., 1926, xli, 1025.

[3] Salmon, *J. Biol Chem.*, 1927, lxxiii, 483; Hauge and Carrick *J. Biol. Chem.*, 1926, lxix, 403.

[4] Chick and Roscoe, *Biochem. J.*, 1927, xxi, 698.

[5] Kinnersley and Peters, *Biochem. J.*, 1925, xix, 8-20, and personal communication of later date.

[6] Williams and Waterman, PROC. SOC. EXP. BIOL. AND MED., 1927, xxv, 63.

[7] Osborne and Mendel, *J. Biol. Chem.*, 1919, xxxvii, 187.

[8] Eddy, Kohman and Carlsson, *J. Indust. and Eng. Chem.*, 1925, xvii, 69.

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Multiple Partition Coefficients of Penetration.

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Overton's lipoid theory[1] which states that only dyes soluble in lipoid can penetrate into living cells, is inadequate in certain re-