the formulae are always reduced to their simplest form and are derived in the clearest, most direct and easily understandable manner. Cross-references and similar complexities that mar most scientific text-books are here reduced to an absolute minimum. The book does not presuppose any particular knowledge of meteorology, but the non-meteorological reader will do well to use the book parallel with one of the numerous non-mathematical accounts of meteorology in order to keep in sight the practical significance of the methods discussed. Otherwise the student will not need more than a general knowledge of college physics and of calculus. Numerous footnotes throughout the book contain carefully selected references to original papers in dynamic meteorology and offer a valuable guide to the reader interested in ampler study in this field.

The first four chapters deal with the application of thermodynamics to the atmosphere, the second law of thermodynamics as far as needed being derived in the book itself. The fifth chapter treats briefly of the effects of solar and terrestrial radiation upon the air. The sixth to ninth chapters deal with the application of the hydrodynamic equations to the simplest cases of atmospheric motions, especially stationary flow. The fundamental equations are again derived in the book itself in a simple manner. The tenth and eleventh chapters contain an account of the theory of turbulence as applied to meteorology; here the simplicity of presentation without loss of comprehensiveness is particularly gratifying. The twelfth to fifteenth chapters deal with a variety of topics, such as the energy of atmospheric motions, the general circulation of the atmosphere, the perturbation theory of atmospheric motions and finally we get a glimpse of the ideas underlying the dynamical theory of fronts and cyclones where there is still much room for controversy and further research. The book brings the student to the threshold of all the important current problems in modern meteorology.

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SPECIAL ARTICLES

THE EFFECT OF INCREASED PANTOTHENIC ACID IN THE EGG ON THE DEVELOPMENT OF THE CHICK EMBRYO[1]

Moderate variations in the intake of the "B vitamins" appear to be without effect on free-living animals. The ingestion of two or more times the daily requirement by an animal not suffering from a deficiency has not been observed to be associated with any special changes of a physiological nature.

Few if any attempts have been made to investigate the effects of a varied level of these vitamins during embryological development, even though the embryo with its special type of metabolism might be expected to respond in a different manner than has been the experience with post-embryological animals.

In the present investigation the pantothenic acid available to the chick embryo was increased in two ways, by direct injection into the egg before incubation and by supplementing the diet of a flock of hens with three times the daily requirement of this vitamin. For injection 100–150 micrograms or about 10 to 15 per cent. of the total pantothenic acid normally present in the egg was dissolved in sterile egg white and injected in this form into the experimental eggs. The control eggs received the same quantity of pure egg white.

The eggs from the hens on the supplemented diet were incubated at different periods after the special diet had been initiated. In this manner eggs can be obtained with varying levels of pantothenic acid up to more than twice the normal concentration.[2] The hens from which the eggs were taken consisted of pure-blooded white Leghorns whose regular diet was well balanced and apparently adequate in all respects.

After 12 days' incubation the control and experi-

TABLE 1

The Effect of Raising the Level of Pantothenic Acid in the Egg 10 to 20 Per Cent. by Injection

Experiment	Number of embryos	Viability control = 100	Hemoglobin control = 100	Relative brain weight control = 100	Relative heart weight control = 100
Control	42				
Pantothenic acid	42		108	107	93
The Effect of Raising the Pantothenic Acid Level of Eggs by Placing Hens on Supplemented Diet					
Group 1—Control	13				
Group 1—Pantothenic acid* .	30	115	116	106	100
Group 2—Control	13				
Group 2—Pantothenic acid ..	31	123	113	103	82
Group 3—Control	8				
Group 3—Pantothenic acid ..	24	130	108	96	83
1 to 3 days after discontinuing supplementary diet					
Group 4—Control	13				
Group 4—Pantothenic acid ..	27	109	119	90	85

* Group 1, eggs collected 4–6 days after initiating supplemented diet; group 2, 7–9 days; group 3, 11–14 days; group 4, 1–3 days after discontinuing supplemented diet.

[1] This investigation was supported by a grant from the Clayton Foundation.

[2] Snell, Aline, Couch and Pearson, *Jour. Nutrition*, 21: 201, 1941.

TABLE 2

The Effect of an Increase of Pantothenic Acid in the Egg on the Vitamin Level of the Liver, Brain and Heart of the Day-Old Chick

Vitamin	Vitamin level of eggs raised by supplementing diet of hens								
	Exper. liver γ/gm.*	Control liver γ/gm.	Exper. liver when control = 100	Exper. brain γ/gm.	Control brain γ/gm.	Exper. brain when control = 100	Exper. heart γ/gm.	Control heart γ/gm.	Exper. heart when control = 100
Pantothenic acid ...	98.0	99.0	99.0	270.0	250.0	108.0	224.0	186.0	120
Inositol	2600.0	2200.0	118.0	8800.0	13000.0	67.5	2700.0	2400.0	113
Nicotinic acid	260.0	410.0	63.5	200.0	230.0	87.0	262.0	246.0	107
Riboflavin	40.0	51.0	78.5	6.3	6.9	91.2	32.0	34.0	94
"Folic acid"	99.0	180.0	55.0	5.0	7.5	66.7	6.6	6.0	110
Thiamin	5.2	5.7	91.0	2.5	5.3	47.0	2.8	2.9	97
Pyridoxin	1.4	2.4	59.2	2.5	1.3	192.0	.98	.77	127
Biotin	.50	.39	128.0	.028	.038	74.0	.078	.075	104

* γ/gram dry weight.

mental embryos were examined for blood hemoglobin concentration and relative size of the heart and brain. Data on the effect of the varied pantothenic acid level in the egg on hatchability were also obtained.

Six control and six experimental eggs from the group with the highest level of pantothenic acid were allowed to hatch and the liver, heart and brain of these chicks were assayed for several of the "B vitamins."

It is evident from Table 1 that there was a definite tendency for increased pantothenic acid in the egg to be associated with an increased hemoglobin concentration of the blood in the 12-day chick embryo. The effect on the relative brain and heart size depended upon the concentration of pantothenic acid present in the egg. A comparatively low concentration tended to be associated with a larger than normal brain, while both heart and brain were depressed in relative size in the embryos from the eggs with higher levels of pantothenic acid.

Embryo survival was better in every group of the eggs from the hens on the supplemented diet, indicating that a relatively high level of pantothenic acid in the egg is associated with improved hatchability.

The results given in Table 2 show that concomitant with the changes in brain and heart size there was also some shift in the balance and level of the eight vitamins in the tissues for which assays were made. This was especially true for the liver and the brain.

Work in progress indicates that some other members of the "B complex" modify the chick development when their level in the egg is raised to a moderate degree—which tends to confirm the results reported here for pantothenic acid.

It appears that during early embryological development, the chick embryo is highly responsive to a vitamin imbalance created by a moderate increase in the level of one of these food elements. Apparently the embryo is dependent on this vitamin balance even for such fundamental characteristics as blood hemoglobin concentration and brain and heart size.

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THE PHENOMENON OF THIXOTROPY IN HEMOPHILIC AND HEPARINIZED BLOOD[1]

In 1923 Szegvari and Schalek[2] observed a property of gels with hydrous ferric oxide for which the term "thixotropy" was suggested by Péterfi in 1927.[3] Ever since it has often been observed that an apparently solidified gel or a very viscous colloid can be liquefied by shaking or other mechanical agitation and upon standing again becomes a gel. This process, in which the time factor becomes apparent, can be repeated and is dependent upon temperature. Previous to this observation in Freundlich's laboratory[2, 4] Chambers[5] had observed in 1921 that frequently protoplasm becomes fluid by stirring with the micro-manipulator needle, and after some time becomes gelatinous again when permitted to stand. It is of great interest and it should be recognized that the phenomenon of thixotropy was described for the first time in 1910 by Howell[6] in studies of the conversion of fibrinogen to fibrin by the addition of thrombin in various amounts. He referred to observations on a similar process in horse's plasma at an earlier time.[7] Minot and Lee[8] observed this

1 Aided by a grant from the Dazian Foundation for Medical Research.

2 A. Szegvari and E. Schalek, *Kolloid-Z.*, 32: 318, 1923; 33: 326, 1923.

3 T. Péterfi, *Arch. f. Entwcklngsmech. d. Organ.*, 112: 660, 1927.

4 H. Freundlich, *Kolloid-Z.*, 46: 289, 1928.

5 R. Chambers, *Proc. Soc. Exp. Biol. and Med.*, 19: 87, 1921.

6 W. H. Howell, *Am. Jour. Physiol.*, 26: 453, 1910.