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The Thyroid and the Rate of Cell Division.

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Among the many investigations on the thyroid gland, few have dealt directly with the relation of the thyroid secretion to the rate of cell division. These few experiments, with a single exception, have been carried out on cultures of protozoa and since they have been subject to certain difficulties of control, due to the material used, the results have given rise to a rather great divergence of opinion. Nowikoff,¹ Shumway,² and others have found that the addition of total thyroid to *Paramecium* cultures accelerated the rate of cell division and more recently Cori³ has reported that pure thyroxin exerts the same effect, although the acceleration is less marked. Woodruff and Swingle⁴ and Torrey, Riddle and Brodie,⁵ on the other hand, have found that the addition of thyroxin depresses the division rate of *Paramecia* and Torrey⁶ reports that thyroxin has the same effect on the eggs of *Echinometra* and *Phallusia*.

In the present work, of which this paper is a preliminary report, the writer has undertaken to follow critically the effect of thyroxin solutions on the cleavage rate of *Arbacia* eggs. Previous work has shown that the developing eggs of *Arbacia punctulata*, properly handled, are very satisfactory for quantitative work. In each experiment, eggs from a single mature female were fertilized with sperm from a single mature male and then placed in experimental and control dishes kept side by side in a large vessel of water, so that errors due to temperature differences were eliminated. Samples of eggs removed at intervals of 1 or 2 minutes from experimental and control dishes were transferred to watch glasses containing formalin which immediately arrested development. Counts of 200 to 300 eggs were made from each sample taken. In making up the thyroxin solution, pure crystalline thyroxin (Squibb) was first dissolved in about 5 cc. of N/1000 NaOH, and then added to sea water

¹ Nowikoff, M., *Arch. f. Protistenkunde*, 1908, xi, 309.

² Shumway, W., *J. Exp. Zool.*, 1917, xxii, 529.

³ Cori, G. T., *Am. J. Physiol.*, 1923, lxxv, 295.

⁴ Woodruff, L. L., and Swingle, W. W., *Am. J. Physiol.*, 1924, lxxix, 21.

⁵ Torrey, H. B., Riddle, M. C., and Brodie, J. L., *J. Gen. Physiol.*, 1925, vii, 449.

⁶ Torrey, H. B., *Endocrinology*, 1928, xii, 65.

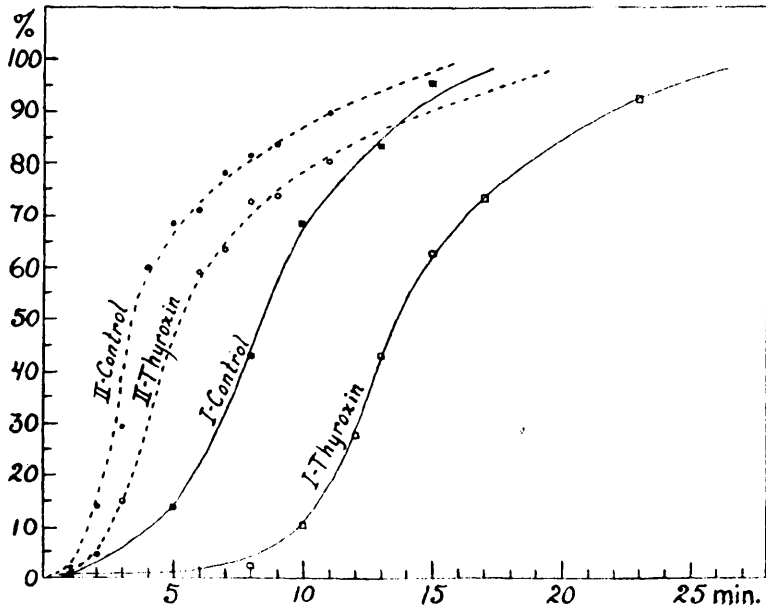


FIG. 1.

The relative effectiveness of thyroxin solutions in retarding the first cleavage of *Arbacia* eggs. Ordinate = percentage of eggs showing the first cleavage; abscissa = time in minutes. Curve I = thyroxin solution 1:50,000; curve II = thyroxin solution 1:100,000.

to make the proper concentration; in each experiment an equal amount of NaOH was added to the sea water in the control dish. In none of the concentrations used did the thyroxin change the pH of the sea water.

The relative effectiveness of thyroxin in 2 different concentrations, one of 1:50,000 and one of 1:100,000, in retarding the first cleavage of *Arbacia* eggs is shown by the curves in Fig. 1. Curves I show that thyroxin in sea water in a concentration of 1:50,000 retards the time of formation of the first cleavage furrow approximately 5 minutes. That this retarding action of the thyroxin persists through later cleavages has been definitely determined by counts made of later cleavage stages, and when followed through to the following day, when the eggs in the control dish had developed into free-swimming, ciliated plutei, the eggs in the experimental dish were far less developed, with no free-swimming forms and a large percentage of abnormalities.

With a thyroxin concentration of 1:100,000 the resulting retardation in the rate of cleavage is approximately half as pronounced as in the 1:50,000 solution. In the experiment represented by curves II in Fig. 1 the 1:100,000 concentration of thyroxin retarded the

time of formation of the first cleavage division approximately 2 minutes. Later cleavages in this experiment were correspondingly retarded, and 17 hours after the completion of the first cleavage, when virtually 100% of the control eggs had become normal, free-swimming plutei, none of the experimental eggs had progressed to the swimming stage and again there were many abnormalities evident.

In experiments in which solutions having a thyroxin concentration of greater than 1:50,000 were used the effect was correspondingly more pronounced. In thyroxin solutions of 1:25,000 for example, the reduction of the rate of division is approximately twice that produced by the 1:50,000 solution. Thus far, however, the writer has not experimented with solutions of so great a concentration that cleavage is entirely inhibited; this point is still to be determined. As would be expected, when solutions of thyroxin with concentrations of less than 1:100,000 are used the retardation is much less pronounced, until in solutions where the concentration was very slight the effect fades out altogether. In solutions of low concentration the results naturally are not so clear cut, for the eggs must be followed for several hours through several cleavages and often to the gastrula to note the retardation.

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Microbic Studies of Acute Infections in Animals (Albino Rat) Deprived of an Adequate Supply of Vitamin A.

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Previous investigators¹ have repeatedly shown that experimental animals (Albino rats), placed on diets deficient in vitamin A, develop a characteristic susceptibility to infection. Goldblatt and Benischek² mention that smears made of tongue abscesses in animals

¹ McCollum, E. V., *J. Am. Med. Assn.*, 1917, lxxviii, 1379; Drummond, J. C., *Biochem. J.*, 1919, xiii, 95; Daniels, Amy L., *J. Am. Med. Assn.*, 1923, lxxxii, 828; Macy, Icie, G., Outhouse, J., Long, M. L., and Graham, A., *J. Biol. Chem.*, 1927, lxxviii, 152; Sherman, H. C., and Burtis, M. P., *PROC. SOC. EXP. BIOL. AND MED.*, 1928, xxv, 649.

² Goldblatt, Harry, and Benischek, Marie, *J. Exp. Med.*, 1927, xli, 699.