It is to be concluded that the commercial preparations of sodium taurocholate used in this study do not contain a principle similar in action to the ovarian hormone.

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Studies on Simple Goiter Produced by Cabbage and Other Vegetables.

DAVID MARINE, EMIL J. BAUMANN AND ANNA CIPRA.

From the Division of Laboratories, Montefiore Hospital, New York.

Chesney, Webster and Clawson[1, 2, 3] have shown that when fresh cabbage *(Brassica oleracea)* is fed to rabbits as the principal food, clinically detectable thyroid hyperplasia occurs in 2 or 3 months, and with continued cabbage feeding very large goiters (up to 45 gm.) have been produced. They further showed that the development of goiter was associated with a lowering of the metabolism and that the administration of small amounts of iodine readily raises the metabolic rate in goiterous rabbits and prevents thyroid hyperplasia. In these respects, as well as histologically, the thyroid hyperplasia produced by feeding cabbage is identical with that of simple or endemic goiter.

We have confirmed these findings.

Boiling or steaming cabbage for 30 minutes increases its capacity to produce thyroid hyperplasia. Steaming for 15 minutes is less effective and steaming for 60 minutes renders it neither more nor less potent than for 30 minutes. Steamed cabbage from which 60% of the weight is removed as press juice is practically as effective as whole cabbage when fed in calori-equivalent amounts. Hashed fresh cabbage has very little capacity to produce thyroid hyperplasia, while hashed steamed cabbage fully retains this quality. In our hands the press juice of 500 gm. of steamed cabbage (300 cc.) when fed daily to rabbits whether whole or concentrated *in vacuo* was only slightly effective.

Rabbits previously iodized and fed with fresh cabbage up to 75 calories per kg. per day (3 gm. of cabbage are equivalent to approx-

[1] Chesney, A. M., Clawson, T. A., and Webster, B., *Johns Hopkins Hosp. Bull.*, 1928, xliii, 261.

[2] Webster, B., Clawson, T. A., and Chesney, A. M., *Johns Hopkins Hosp. Bull.*, 1928, xliii, 278.

[3] Webster, B., and Chesney, A. M., *Johns Hopkins Hosp. Bull.*, 1928, xliii, 291.

imately 1 calorie) developed palpable thyroids in about 30 days, while with the same amount of steamed cabbage only 10 to 15 days were necessary. The lowering of the metabolic rate to the thyroidectomy level (from about 2.4 to 1.75 calories per kg. per hour) would also occur in about half the time required if fresh cabbage were used. Winter cabbage is much more effective than summer cabbage. Steamed winter cabbage is effective when fed in amounts as low as 25 calories per kg. per day. It may be effective below this level although this cannot be stated with certainty because the thyroid is very labile and, as is well known, hyperplasia may be produced by a great variety of food stuffs, cracker dust to mice (Hunt), fats to pigeons (McCarrison), liver to dogs, fowls, trout (Marine and Lenhart). Fresh or steamed carrots *(Daucus carota)* and lettuce *(Lactuca sativa)* when fed in amounts up to 75 calories per kg. per day have no thyroid hyperplasia producing qualities. Mangel roots *(Beta vulgaris,* var. *macrorhiza)* when fed either fresh or steamed have slight goiter producing qualities. Fresh turnip *(Brassica campestris* and *Brassica rapa)* is practically ineffective. If steamed for 30 minutes, turnip has a moderate goiter producing quality. Brussels sprouts *(Brassica oleracea,* var. *bullata gemmifera)* and cauliflower *(Brassica oleracea botrytis)* also produce thyroid hyperplasia approximately to the same degree as cabbage and their goiter producing quality is likewise greatly increased by steaming.

The isolation of a powerful reducing substance from cabbage and also from ox suprarenal cortex by Szent-Györgyi[4] which he identified as a hexuronic acid suggested the possibility that this substance might be a factor in the production of thyroid hyperplasia since such a reducing factor could be correlated with our often expressed conception that the suprarenal cortex contains a hormone capable of exerting a regulatory or inhibitory effect on many physiological activities including heat production. Sterile fractions containing this substance in amounts varying from 16 to 32 mgm. (as determined iodometrically) injected into rabbits intraperitoneally daily for 30 days did not produce thyroid hyperplasia. Indeed, the opposite effect (involution) occurred.

Although cabbage is an excellent food for rabbits it is evident that it contains a powerful goiterogenic agent which can be destroyed by enzymes existing in the plant and which can be preserved for many days when these enzymes are destroyed by heat. Like other goiterogenic agents it exhausts the thyroxine store in the

[4] Szent-Györgyi, A., *Biochem. J.*, 1928, xxii, 1386.

thyroid and hyperplasia follows when this exhaustion reaches the critical level. The thyroid hyperplasia is therefore due immediately to a relative deficiency of iodine and an iodine store sufficient to maintain normal thyroid structure for from 3 to 6 months may be exhausted in 2 weeks by feeding steamed cabbage. The possibility that the thyroid hyperplasia due to feeding cabbage is dependent upon an absolute iodine deficiency can be dismissed.

The mode of action of this goiterogenic agent is unknown, although the data available suggest that it acts by depressing some oxidation system which the thyroid attempts to overcome.

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Contribution to the Problem of the Origin and Development of the Sympathetic Nervous System.

ERNEST VAN CAMPENHOUT. (Introduced by H. S. Burr.)

From the Department of Anatomy, Yale University School of Medicine.

Three theories have been proposed regarding the origin of the sympathetic elements, the neural crest, the ventral half of the spinal cord, or the mesodermal tissue. The experimental method alone is able to give a satisfactory answer to this problem.

In embryos of *Rana pipiens*, at the stage of open or closing neural folds, the author has removed the neural crest from the hindbrain to the tip of the tail; the entire spinal neural crest and the dorsal half of the spinal cord were excised by that procedure. Many operated embryos live as long as 45 days after the operation. Their size was very much reduced if compared with the control animals and they showed marked deficiency in their sensitivity. The microscopic study of these embryos shows the absence of the spinal and sympathetic ganglia throughout the entire trunk region. The motor roots are present in all segments but are lacking sheath cells. The spinal cord shows normal motor neurones; the Rohon Beard elements are absent and the central canal is more or less dilated. The chromaffin part of the adrenals is undeveloped and the digestive tube does not show any nervous elements in its walls.

The removal of the hindbrain at the same embryonic stage does not interfere with the development of a vagal ganglion. Its visceral branch is, however, absent. The visceral portion of the vagus nerve seems to be exclusively derived from the medullar neural crest, the other components originating from the placodes. In these embryos