consensual (of the normal eye) constriction was found when a light of 60 watts at a distance of 1 meter was projected on the experimental (right) eye. Great care was taken to insure that no amount of light would reach the normal (left) eye. In several experiments a heavy bandage was placed on the normal eye; in the other cases where the consensual reaction of the other eye was to be recorded, this eye was carefully protected against direct stimulation. The direct pupillary response was found to be minimal-achange from 0.1 to 0.5 mm. The consensual response, *i. e.,* from the experimental eye to the normal eye was slightly more conspicuous, showing constriction of 0.5 to 1.5 mm, while the consensual reaction from the normal to the operated eye manifested by a decrease of 2.0 to 3.0 mm in the pupillary diameter.

Our experiments indicate that there is some restitution of function of afferent fibres going to the pupillary centers in the cut optic nerve which actually is central nervous tissue. Anatomic studies have not been completed.

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Bone Calcium During Hyperthyroidism.

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Parhon[1] observed an increased excretion of calcium in rabbits fed thyroid gland. This increased excretion of calcium has also been reported by other authors.[2-5] Aub, *et al.,*[6] have also observed an increased excretion of calcium in the feces of hyperthyroid patients. Others have demonstrated, by the use of roentgenograms, a decalcification in patients with hyperthyroidism. In order to account for the increased calcium excretion in thyroid-fed animals and for the

1 Parhon, M., *Mem. Soc. de biol.*, 1912, **72**, 620.

2 Kummer, R. H., *Rev. Med. de la Suisse Romande*, 1917, **37**, 439.

3 Hunter, D., *Lancet*, 1930, **1**, 947.

4 Pugsley, L. I., and Anderson, E., *Biochem. J.*, 1934, **28**, 754.

5 Cope, O., and Donaldson, G. A., *J. Clin. Invest.*, 1937, **16**, 329.

6 Aub, J. C., Bauer, W., Heath, C., and Ropes, M., *J. Clin. Invest.*, 1929, **7**, 97.

osteoporosis observed in human hyperthyroidism, Aub, *et al.*,[6, 7] assumed that an excess of thyroid has a specific catabolic action on the calcium deposits in bone, leading to an increased mobilization and excretion of calcium. However, Hansman and Wilson[8] and Beaumont, *et al.*,[9] have shown that the calcium and phosphorus balance may be positive during thyrotoxicosis. In 6 cases (Beaumont, *et al.*) the calcium excretion remained the same after as before successful operation. These authors believe that some other cause than a specific catabolic effect of an excess of thyroid on bone must be sought to explain the increased calcium excretion and decalcification that is seen in some patients with Grave's disease. Hansman and Wilson, in a review of the literature, and from their own studies, favor the view that an associated hyperparathyroidism is the direct cause of an increased mobilization and excretion of calcium.

Little experimental work has been done to lend support to either view. Hoskins[10] reported an increase in the weight of the bones, in both the wet and dry state, of thyroid-fed rats. Smith and McLean[11] studied the ash content of the femur of thyroid-fed rats and concluded that, with a diet adequate in calcium, severe hyperthyroidism does not produce decalcification. Only one report of the calcium content of bones during experimental hyperthyroidism has appeared. Parhon, *et al.*,[12] reported a slight decrease in the calcium content of the bones of thyroid-fed dogs. Their analyses show considerable variation and make their conclusions of doubtful significance. We, therefore, undertook a study of the calcium content of the femur of thyroid-fed rats.

Adult male rats, averaging 250 g in body weight, were fed, *ad libitum*, a diet consisting of: salts (Osborne and Mendel), 4; cod liver oil, 4; Crisco, 10; casein, 20; and cornstarch, 62 parts. A supplement of 200 mg of dried yeast was fed each day. This amount of yeast will not prevent a loss of weight in the thyroid-fed rats.[13, 14] The thyroid-fed rats received 100 mg of desiccated thyroid gland

[7] Albright, F. W., Bauer, W., and Aub, J. C., *J. Clin. Invest.*, 1931, **10**, 187.

[8] Hansman, F. W., and Wilson, F. H., *Med. J. Australia*, 1934, **1**, 37, 81.

[9] Beaumont, G. E., Dodds, E. C., and Robertson, J. D., *J. Endocrinology*, 1940, **2**, 237.

[10] Hoskins, E. R., *J. Exp. Zool.*, 1916, **21**, 295.

[11] Smith, E. E., and McLean, F. C., *Endocrinol.*, 1938, **23**, 546.

[12] Parhon, C. I., Derevici, H., and Derevici, M., *Compt. rend. Soc. de Biol.*, 1932, **109**, 1396.

[13] Drill, V. A., PROC. SOC. EXP. BIOL. AND MED., 1938, **39**, 313.

[14] Drill, V. A., and Sherwood, C. R., *Am. J. Physiol.*, 1938, **124**, 683.

per day.* Calcium was determined in the ash of the fat-free femur by the method of Washburn and Shear.[15]

After 25 days of thyroid feeding the rats had lost an average of 56 g, whereas the control rats had gained an average of 12 g in body weight. The rats were then dissected. The percentage of ash in the fat-free femur of the thyroid-fed animals (10 rats) showed a slight, but statistically insignificant drop from the value of the control animals (8 rats). The femur calcium of the thyroid-fed rats varied from 35.28 to 40.19% with a mean value of 38.55 ± 0.616, whereas the control rats varied from 38.08 to 42.31% calcium with a mean of 41.21 ± 0.570. Although the difference of 2.66% between the means is statistically significant, this difference seems slight when it is remembered that the experimental group had lost 23% of their body weight during thyroid feeding.

The diet used was relatively rich in calcium, containing 0.48% calcium. During the experiment the thyroid-fed animals showed an increased food consumption with a consequent increase in calcium intake, which would aid in maintaining a positive calcium balance in the thyroid-fed rats. The high calcium diet and the increase in food intake may have prevented a greater reduction in bone calcium than that actually found. But, at least thyroid feeding does not seem to have had any marked catabolic effect on the bones with a diet adequate in calcium. Other rats on the same diet, which have been fed 100 mg of thyroid gland for 80 days, plus a supplement of vitamin B_1 and yeast to prevent a loss of weight,[14] did not show any detectable osteoporosis upon X-ray examination.

These results, based on the measurement of bone calcium, point to the same conclusions reached by Hansman and Wilson[8] and Beaumont, *et al.*,[9] in clinical studies. The experiments also confirm the conclusion of Smith and McLean,[11] who, in a study of the ash content of the bones of hyperthyroid rats, concluded that with a diet adequate in calcium, severe hyperthyroidism does not produce osteoporosis.

Summary. Rats fed 100 mg of thyroid gland per day showed, after 25 days, an average decrease of 2.66% in the calcium content of the ash of the fat-free femur. The concomitant loss in body weight of 23%, makes it unlikely that the thyroid feeding *per se* had a specific effect on bone calcium.

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15 Washburn, M. L., and Shear, M. J., *J. Biol. Chem.*, 1932, **99**, 21.