difficulty. This on hydrolysis in the presence of NaCl would yield HCl. That certain of the leucocytes carry the Ca and P for this process is probable as well as that they serve to carry away the basic phosphate which however would be formed in smaller amounts than corresponds to Maley's conception. Assuming (which is not necessarily the case) that all phosphoric acid were split off as acid Ca phosphate we should expect the gastric juice to contain appreciable amounts of acid Ca phosphate and that this might be roughly proportional to the acidity. The former is apparently correct, while the latter appears from the few cases studied, to be probable.

Confirmatory of this view are the findings of high acidity and efficient digestion associated with hyperfunction of pituitary and thyroid and the opposite with hypofunction. Also the decrease of gastric secretion after parathyroidectomy (Keeton[1]), aided by Ca salt administration; and favorable effect on acid secretion in some achylias of parathyroid treatment (Rehfuss[2]). These presumably act by a stimulation of the nucleolysis necessary for acid production or by mobilizing the acid carrying cells. These relations are still being investigated.

15 (947)

Phospho-nuclease as related to phosphorus and calcium metabolism.

By OLAF BERGEIM.

[*From the Laboratory of Physiological Chemistry of Jefferson Medical College.*]

Studies made in this laboratory of the Ca metabolism in certain ductless gland disturbances have emphasized to us the unsatisfactory nature of the views held with regard to Ca distribution and calcification. In our case of acromegaly[3] with hyperfunction of hypophysis Ca absorption and excretion were marked, the absorption apparently taking place even from the difficultly

[1] Keeton, *Am. J. Physiol.*, 33, 25, 1914.

[2] Rehfuss, unpublished results from this laboratory.

[3] Bergeim, Stewart and Hawk, *J. Exp. Med.*, XX, 218, 1914.

soluble residue in the lower intestine. After parathyroidectomy[1] absorption and excretion were very low. The Ca content of the blood however increased slightly which has been shown for *P* also by Greenwald.[2] There is decreased *P* catabolism but increase in the blood and Ca deprivation of tissues due to impaired excretion. Hyperthyroidism with its nervous symptoms would represent increased catabolism with more normal excretion. The apparent opposition of thyroid and parathyroid is likewise explained by greater catabolism in presence of thyroid than in absence of both.

These facts and a host of others related to endocrinous gland function may be interpreted briefly as follows. The intestinal epithelium and leucocytes invading it (probably the splanchnic basophiles) by virtue of the phosphonuclease they contain liberate from nucleic acid (possibly other phosphoric esters also) phosphoric acid which dissolves Ca phosphate. Ca is carried partly in combination with the leucocytes and is necessary for nucleolytic action. Macallum[3] has shown these cells to absorb and transport iron salts. Westbrook found the cells in extremely large numbers in villi of carnivora, particularly the dog (bone ingestion?).[4] In decalcification of bone the osteoclasts act in a similar manner. In ossification the osteoblasts split off acid Ca phosphate which hydrolyzes to the carbono-phosphate.

The question as to why only certain tissues as cartilage calcify is a distinct problem but may be largely a matter of chemotaxis. As cartilage seems to have a specific adsorption affinity for Ca salts and as Ca salts introduced from without stimulate ossification, Ca salts are probably the agents of the chemotaxis. Likewise in pathological calcification, degeneration with liberation of phosphoric acid in the tissue would lead to primary deposition which would be continued by the leucocytes. Calcification in the embryo chick must be analogous.

The parathyroid must act by stimulating these processes as instanced by parathyroid hyperplasia with osteomalacia and atrophy with rickets, infantilism, osteitis deformans. Interesting

[1] Bergeim, Stewart and Hawk, *J. Exp. Med.*, XX, 225, 1914.

[2] Greenwald, *J. Biol. Chem.*, XIV, 363, 369, 1913.

[3] Macallum, *Jour. Physiol.*, 16, 268, 1894.

[4] Westbrook, *J. Physiol.*, 18, 490, 1895.

is the increased resorption *and* deposition in acromegaly with high P metabolism. Other less essential glands as the thymus apparently act mainly as supplies and stores of nuclein.

The importance of phosphoric acid for oxidation processes as fermentation is readily correlated on this basis with disturbances of carbohydrate oxidation (diabetes, decreased oxidation with hypofunction and increased with hyperfunction of pituitary and thyroid, and other well known examples). As indicated above, as well as by tartrate production of nephritis, excretion by kidneys and intestine as well as maintenance of blood neutrality are much more than simple mass action and filtration processes.

16 (948)

The effect of lead on the germ cells of the male rabbit and fowl as indicated by their progeny.[1]

By L. J. COLE and L. J. BACHHUBER.

[*From the Department of Experimental Breeding, Wisconsin Agricultural Experiment Station.*]

The experiments of Stockard[2] on guinea pigs and of Cole and Davis[3] on rabbits have shown conclusively that alcohol has a deleterious effect on the germ cells of the male. In the experiments here reported lead, in the form of lead acetate, was substituted for the alcohol, lead being chosen because of its reputed effect upon the offspring of workers, whether male or female, in trades where they are exposed to lead in its various forms. The method of double mating described by Cole and Davis was employed. This consists in breeding a female of a certain type to two males at the same period. The males are of such gametic constitution that the young of each may be identified by color or other characteristics. The experimental animals used were

[1] Papers from the Department of Experimental Breeding of the Wisconsin Agricultural Experiment Station, No. 3.

[2] See especially "The effect on the offspring of intoxicating the male parent and the transmission of the defects to subsequent generations," *Amer. Nat.*, Vol. 47, No. 563, pp. 641–682, 1913.

[3] "The effect of alcohol on the male germ cells, studied by means of double matings," *Science* (N. S.), Vol. 39, No. 1004, pp. 476–477, 1914.