these conditions than cyanocobalamin.

Summary. Hydroxocobalamin, when injected intramuscularly into dogs, produces more prolonged elevation of serum Vit. B_{12} than does injection of equal quantities of cyanocobalamin. The possible physiological significance of this observation is discussed.

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Bile Salt Absorption at Various Levels of Rat Small Intestine.* (26163)

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Frolicher(1), using an *in vivo* technic, showed that the terminal ileum of the rat has the ability to absorb cholates more rapidly than does the upper jejunum. The upper jejunum, in turn, was shown to be a better cholate absorber than the duodenum. The present investigation confirms and extends Frolicher's findings.

Methods. The experiments were performed on adult, male, albino rats (Holtzman Co.) which had been fasted for 24 hours with access to tap water. Extract of Ox Bile, N. F. (Wilson Laboratories) was used as a source of conjugated cholate. The bile salts in this preparation consist principally of sodium glycocholate and sodium taurocholate. An approximately 1.0% solution of Extract of Ox Bile in distilled water was used as the initial test solution. The cholate concentration of this solution in the various experiments ranged from 11.6 to 13.2 μmoles per ml.

An *in vivo* isolated loop technic was used. An attempt was made to overcome two major problems often encountered in such technics: (a) the progressive decrease in intralumenal hydrostatic pressure, and (b) the difficulty in completely removing all of the remaining test solution from the loop at end of experiment.

Each animal was anesthetized with sodium pentobarbital (about 40 mg/kg, I.P.); its abdomen was opened in the midline; and a segment of small intestine, roughly 10 to 15 cm long was cannulated at both ends. The position of the segment along the intestine varied from animal to animal. The bile duct was tied off if it entered the loop of intestine selected. The cannulae were connected

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through 3-way stopcocks to two 10 ml syringes ("A" and "B"). The abdomen was closed and the segment rinsed with three 10 ml portions of 0.9% NaCl from syringe A, then emptied by flushing with air. The segment was then rinsed from syringe A with two 10 ml portions of the same bile salt solution that would subsequently be used in the test period (this was called the "conditioning rinse"), and flushed with air until no further fluid could be removed by passage of air through the loop. A 10.0 ml portion of test solution was then placed in syringe A and allowed to infuse into the segment and up into the barrel of syringe B (without plunger) to a height of about 4 cm above the tips of the cannulae. About 4 ml of solution remained in syringe A.

During the test period syringe barrel B was left open to the loop, thus serving as a reservoir. The intralumenal hydrostatic pressure was maintained within narrow limits by addition of test solution to this reservoir. After a one hour test period the system was drained from the stopcock on syringe B and flushed with air. The amount of cholate remaining in the system was expected to be quite close to the amount present in the system before the test period began (as a result of the conditioning rinse), thus eliminating the necessity of attempting to remove all of the residual solution at the end of test period by means of a series of rinses.

To test this contention a series of immediate recovery experiments were performed. After the conditioning rinse was removed, 10.00 ml of test solution were placed in the system, allowed to rise into syringe B in the usual manner, then promptly removed from the system without allowing appreciable time for absorption to occur. Mean recovery from 4 animals was 98.2% with a standard error of $\pm$ 0.15%. This recovery was considered to be satisfactory.

The volume of recovered solution was measured to the nearest 0.1 ml and cholate concentration determined by the photometric method of Irvin, Johnston, and Kopala(2). Amount of cholate absorbed was calculated by subtracting the amount recovered after the test period from that present in the 10.0 ml of test solution used (plus amount present in any additional test solution used to maintain the hydrostatic pressure).

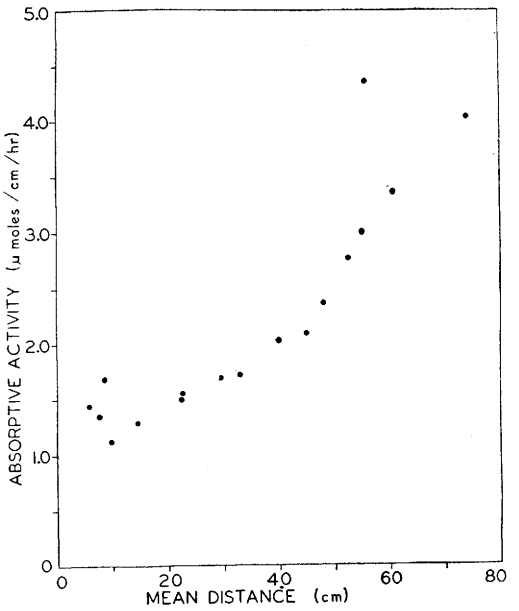

FIG. 1. Absorptive activity for cholate as a function of distance from pylorus.

After the experiment the small intestine including the loop studied was excised, placed in a metal trough filled with Ringer's solution at 20 to 25°C, gently straightened without stretching, and floated alongside a centimeter scale. In this way length of the loop, and distance from pylorus to middle of the loop (mean distance) were measured.

Results. The results obtained in 17 animals are shown in Fig. 1. In this figure absorptive activity, defined as μmoles of cholate absorbed per cm of intestine per hour, is plotted against the mean distance of the segment from the pylorus. Absorptive activity for cholate increased as the intestine was descended. The slope of the best fitting straight line through the points was significantly greater than zero at the 0.1% level of confidence. However, absorptive activity appeared to be an exponential function of mean distance.

Discussion. The absorption of bile salt is a more important function of the intestine than might immediately be apparent. A large percentage of the secreted cholate must be reabsorbed by the intestine to maintain the

cholate level in the enterohepatic circuit requisite to normal lipid absorption. The observed pattern of absorptive activity along the intestine would seem to be ideally suited to the dual function of keeping the cholates in the lumen to promote lipid absorption for as long as possible and yet allowing their eventual recovery to the animal.

The existence of such a gradient in absorptive activity indirectly supports the idea that some specific system exists in the mucosal epithelium to absorb cholate. The magnitude of the cholate gradient becomes more striking when one considers that the mucosal surface area per unit length of small intestine decreases with distance from the pylorus(3).

It is interesting to note that this gradient for bile salt *in vivo* is oriented in the opposite direction to the absorptive activity gradients for glucose along the small intestine of the rat(4), and for palmitic acid along the hamster small intestine(5) observed in experiments with surviving small intestine *in vitro*.

Kremen, *et al.*(6) have shown in dogs that a much greater defect in fat absorption occurs when the distal half of the small intestine is resected than when the proximal half (below the duodenum) is removed. The possibility should be considered that the marked fat absorption defect observed by these authors after distal resection resulted from elimination of a highly active area of bile salt absorption with a consequent decrease in amount of cholate in the enterohepatic circuit, and did not necessarily reflect a greater inherent ability of the distal small intestine to absorb fat.

Summary. Using an *in vivo,* acute loop technic it has been shown in the rat that absorptive activity for conjugated cholate increases nearly 4-fold as the small intestine is descended from duodenum to terminal ileum.

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Pyridoxine Deficiency in Hyperthyroidism.* (26164)

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Hyperthyroidism is associated with an increased requirement not only of calories, but also of essential micronutrients. When they are not provided in the daily dietary, or fail to be utilized, weight loss and nutritional deficiencies may ensue.

Among the main micronutrients whose quantitative requirements are elevated in experimental hyperthyroidism are certain of the B complex vitamins. Thus, Cowgill and Palmieri concluded from experimentally produced thyrotoxicosis that there is some relation between amount of B requirement for maintainance of weight and metabolism of the organism(1). In view of the fact that B-6 is involved in a great many enzymatic reactions, it seemed advantageous to investigate pyridoxine metabolism in hyperthyroidism in man.

Material and methods. The presence of B-6 complex is required for metabolic breakdown of tryptophan. In induced B-6 deficiency, derangement of tryptophan metabolism is manifested by increased excretion of xanthurenic acid after a tryptophan load(2). Administration of B-6 corrects this aberration

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