

vision. Up to the present, 6 to 12 weeks after the resection-vagotomy operations, the return of hydrochloric acid to preoperative values has persisted in all of the animals except when an occasional biliary regurgitation modifies it (observed in 1 dog). In the main stomach or its remnant the amount of free hydrochloric acid in the contents after a test meal varied with the degree of neutralization by regurgitated intestinal fluids, and the amount of fixation of the acid radical by the protein in the meal and the protein in the mucus secreted by the gastric glands. On the other hand, in the pouch the secretion elicited after a test meal consisted nearly entirely of free hydrochloric acid, only a small amount being bound by the protein in the mucus.

The results of these experiments show that in the dog, subtotal gastrectomy combined with double infra-phrenic vagotomy induces only a temporary reduction in gastric acidity which is followed by a complete return of secretory function. Apparently the stomach is endowed with highly efficient compensatory mechanisms which provide for the continued production of hydrochloric acid under such conditions. The fact that the division of both vagi does not abolish the action of atropine indicates that the intrinsic postganglionic vagus mechanism remains intact.

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### Further Studies on Continuous Secretion of the Pancreas.

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In a previous communication<sup>1</sup> observations were presented which indicate that in the dog pancreatic secretion is continuous during interdigestive periods, as it is in rabbits and ruminants. In another paper<sup>2</sup> we have discussed the inhibitory effect of ether anesthesia on continuous secretion, which explains the absence of continuous flow in the acute experiments of Bayliss and Starling. It has been claimed that continuous secretion in permanent fistulas is

<sup>1</sup> Berg, B. N., and Zucker, T. F., *PROC. SOC. EXP. BIOL. AND MED.*, 1931, **28**, 724.

<sup>2</sup> Zucker, T. F., Newburger, P. G., and Berg, B. N., *PROC. SOC. EXP. BIOL. AND MED.*, 1931, **29**, 294.

due to lack of neutralization of gastric hydrochloric acid by the pancreatic juice diverted from the intestine.<sup>3</sup>

In order to determine whether this factor has an effect on continuous secretion the following experiment was performed. A dog was prepared with a system of altercursive intubation as described by Elman and McCaughan<sup>3</sup> by means of which the pancreatic juice was continuously returned to the intestine through the biliary tract. This consists of an intercommunicating system of tubes leading from the pancreas to the gall bladder in such a way that the flow of juice can be observed on the outside. By this procedure the pancreatic secretion was allowed to enter the duodenum through the ampulla of Vater and neutralization of the gastric juice could take place as in the normal animal. Elman<sup>4</sup> states that the gastric hypersecretion which he reports as accompanying complete drainage of pancreatic juice to the outside, does not occur under these conditions.

Two types of experiments were performed on dogs with altercursive intubation. A T-tube manometer was inserted in the outer circuit to measure the maximum pressure developed during secretion and a dropping bulb to count the number of drops secreted per minute was arranged in such a way that the juice from the pancreas appeared in drops from a jet at the top of the bulb and was returned from the bottom of the bulb to the intestine via the gall bladder. Our observations show clearly that with uninterrupted return of juice to the intestine, continuous secretion could be demonstrated even in animals deprived of food for more than 24 hours. The pressure measurements were of the same order of magnitude as with complete drainage to the outside previously recorded. The fasting secretion developed a pressure equivalent to about 280 mm. of juice and after giving food this rose to about 320 mm.

Therefore, unless we want to assume that all procedures, such as intubation of ducts, lead to grossly erroneous results, we must conclude that with experimental conditions as nearly normal as possible, the pancreatic secretion of the dog is continuous during fasting. At any rate, all explanations of continuous secretion as an abnormal effect due to lack of neutralization of gastric hydrochloric acid become untenable.

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<sup>3</sup> Elman, R., and McCaughan, J. M., *J. Exp. Med.*, 1927, **45**, 561.

<sup>4</sup> Elman, R., *Arch. Surg.*, 1928, **16**, 1256.