17.6 to 55.4 mg., for 8 hours. Experiments are under way to determine the effect of bile, feces and mechanical distension on calcium elimination by the intestine.

It is evident from our experiments that calcium is eliminated to a much greater extent by the lower intestinal mucosa than the upper. However, it must be pointed out that the concentration of calcium in the gastric juice is from 5.0 to 6.5 mg. per 100 cc.[2] of pancreatic juice (our own determination) is from 5.0 to 9.0 mg. per 100 mg., and of gall-bladder bile from 6.0 to 17.0 mg. per 100 cc. It is also evident from our experiments that increased activity of the lower ileum and colon caused by hourly washings markedly increases the output of calcium.

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Emptying of Human Gall Bladder After Saline Cathartics.

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In a recent number of the PROCEEDINGS[1] it was shown that magnesium sulphate, when injected directly into the duodenum, produced relatively as great an expulsion of bile from the gall bladder as usually resulted from the first phase of contraction following a meal of egg-yolk. Secondly, the striking change in shape of the cholecystograms made it certain that not merely emptying but also contraction of the gall bladder was induced by the injection of this salt.

Since then, a large number of other salts have been tried, employing the same quantitative method of measuring the response that has been used in our other investigations, namely, computation of successive gall bladder volumes and the plotting of a contraction curve. Up to the present time, this work has revealed the existence of 2 other salts which in strong solutions are as effective as magnesium sulphate, viz., magnesium chloride and sodium sulphate. Furthermore, each of the 2 sulphates when diluted and given by mouth, induce nearly as pronounced an emptying as when given by

[1] Boyden, E. A., and Saunders, A. M., PROC. SOC. EXP. BIOL. AND MED., 1928, xxv, 458.

[2] Austin, W. C., and Matthew, S. A., *Am. J. Phys.*, 1927, lxxxi, 552.

Rehfuss tube. But magnesium sulphate, when given to cats, either by mouth or by duodenal tube, does not induce emptying of the gall bladder. Similar negative findings in dogs have been recorded by Gantt and Volborth.[2] One of the alternative explanations they suggest is therefore probably correct—that there is a species difference in the reaction of the gall bladder. Yet in both animals and man, magnesium sulphate induces active peristalsis of the intestine. This confirms our previous observations (made upon animals in which the common duct had been severed from the intestine) that peristalsis of the duodenum is not a significant factor in the evacuation of the gall bladder.[3]

Further evidence in this direction is supplied by our experience with such other well known hydragogue cathartics as sodium phosphate and citrate, magnesium citrate and Rochelle salts (tartrates of sodium and potassium) all of which induce peristalsis but none of which cause any pronounced emptying of the gall bladder. Indeed, some of these, as well as hypertonic solutions of sodium chloride and sodium bicarbonate, may close the outlet of the common duct and induce sudden relaxation and filling of the gall bladder. It would seem, therefore, that the action of the 3 effective salts mentioned in the preceding paragraph is best explained on the ground of stimulation of sensory nerve endings by certain specific ions—a hypothesis which is being subjected to further experimentation.

Since much has been written about the effect of gastric secretion upon the action of the gall bladder, especial attention during the course of these experiments has been paid to the contents of the duodenum. The chyme was continuously aspirated and careful records were kept of the changing acidity and alkalinity. Occasionally it was found that a sudden change from an acid to an alkaline medium resulted in immediate relaxation and filling of the gall bladder and abrupt changes in the reverse direction sometimes resulted in a slight emptying of the gall bladder. When various solutions of HCl (in strengths usually found in the stomach) were injected into the duodenum, no such consistent results occurred as had been obtained with the use of foods and effective salts; in some cases the gall bladder dilated, in others its contents diminished, the maximum case being 12 cc. as against the maximum of 45 after egg yolk in the same individual, or of 42 cc. after $MgSO_4$ in the instance previously reported.[1] While these experiments confirm the action

[2] Gantt, W. H., and v. Volborth, G., *J. Lab. and Clin. Med.*, 1926, ii, 542.

[3] Boyden, E. A., and Birch, C. L., PROC. SOC. EXP. BIOL. AND MED., 1927, xxiv, 827.

of HCl as reported by Ivy and Oldberg,[4] it would seem that hydrochloric acid plays a very insignificant rôle in the emptying of the human gall bladder.

Finally, a substance has been found—petrolatum—which separates the action of the gall bladder musculature from that around the outlet of the common duct. In the 2 cases in which this inert mineral oil was injected into the duodenum, an initial relaxation of the gall bladder ensued, followed by increased tonus but no diminution of size. Subsequently when egg yolk was injected, the gall bladder again contracted (as evidenced by the shape of the cholecystograms), but was again unable to discharge its contents—due, presumably to a spastic closure of the outlet of the common duct induced by the presence of petrolatum. But when the patient was given a coarse meal which scoured the oil out, the gall bladder emptied about half of its contents. It would seem, therefore, that by the use of petrolatum we had reproduced the conditions recorded spontaneously in a previous case of hour-glass gall bladder in which the biliary vesicle could be induced to contract but the sphincter remained closed.[5]

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Physiological Effects of Temporary Occlusion of the Coronary Vessels.

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From Northwestern University Medical School.

The following experiments were conceived by Dr. Andrew C. Ivy and myself in an effort to explain the acute effects of sudden occlusion of a coronary artery. The assistance of Dr. Ivy and Mr. Leuth has been essential to the success of these experiments. This work may be divided into 3 phases:

EXPERIMENTS OF SERIES I.

Method: Under ether anesthesia and artificial respiration the chest is opened in the 5th left intercostal space. Through a small incision in the pericardium a ligature is passed around the *ramus descendens* anterior sinister branch of the left coronary artery. Without tying, the 2 ends of the ligature are passed through a

[4] Ivy, A. C., and Oldberg, Eric., *Ibid.*, 1928, xxv, 251.

[5] Boyden, E. A., *Ibid.*, 1927, xxv, 99.