turned out to be very good. Out of about 75 independent experiments there were only 3 in which the oxygen consumption of the mixture was not at least 3 times that of the isolated components; often it was 10 times that.

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The Enterogastric Reflex.

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Numerous investigators have reported a delay in gastric evacuation as a result of placing acid, fat, gastric juice, etc., in the duodenum or other parts of the small intestine. The effect has generally been attributed to a reflex (the "Hirsch v. Mering reflex") causing tonic contraction of the pyloric sphincter. However, two studies record inhibition of contractions of the *pars pylorica* following the introduction of acid[1] or fat[2] into the duodenum. Apparently both investigations were made upon the empty stomach, though Edelmann[2] observed inhibition of gastric contractions during secretion of gastric juice. There are no data in either report to prove that the phenomenon occurs in the full stomach or has any bearing on the mechanism of gastric evacuation.

We studied the effect of placing various substances in the duodenum while recording graphically the tone changes in the pyloric sphincter by means of the pressure tonometer,[3] and the contractions of the *pars pylorica* by means of a balloon placed in the pyloric canal. Observations were made before, during and after feeding. A balloon in the pyloric canal of the empty stomach registers contractions which are indistinguishable graphically from digestive peristalsis and are probably aroused by the presence of the balloon. We do not consider them hunger contractions. Dogs were used, some narcotized, others without anesthesia or narcosis. The latter were provided with gastric and duodenal fistulas fitted with cannulas.

HCl N/10 in the duodenum, inhibits the contractions of the *pars pylorica* in both the full and empty stomach. In the former the

[1] Kirschner, M., and Mangold, E., *Mitteil. a. d. Grenzgeb. d. Med. u. Chirur.*, 1911, **23**, 446.

[2] Edelmann, J., *Jahresbericht f. Tier-Chemie (Malys Jahresb.)*, 1906, **36**, 414.

[3] Thomas, J. Earl, *Am. J. Physiol.*, 1929, **88**, 498.

typical effect is decrease in force rather than cessation of contractions. The pyloric sphincter, after a momentary increase in tonus, is likewise relaxed and its rhythmic contractions are inhibited, roughly in proportion to the similar effect on the *pars pylorica*. The effect on both the sphincter and *pars pylorica* is more pronounced when the stomach is empty and is obtained with smaller amounts of acid. In conscious animals with a full stomach the threshold for the inhibitory effect on the stomach is lower than for the primary contraction of the sphincter. In such cases the primary contraction of the sphincter is frequently not observed. With minimal stimuli such as might be expected to occur normally, probably only the gastric contractions are affected. Similar results were obtained using as stimuli gastric contents following a meal of bread with milk or water, hypertonic salt solution, acid sodium phosphate solution, and olive oil. Considerable distention of the duodenum with tap water or isotonic salt solution has a similar, though weaker effect.

The relaxation of the sphincter is slight and probably of little consequence, nevertheless it is interesting in view of the fact that contraction has usually been assumed to result from such stimuli as we used. It would appear that the physiologically significant effects of such stimuli are on the force of the gastric peristaltic contractions.

The nervous mechanism of the reflex was studied in dogs narcotized with morphin following ether anesthesia. HCl N/5 was used as a stimulus. The reflex is readily obtained after section of the splanchnics and after tightly ligating the pylorus over a metal plug in the lumen. It was not observed after section of the vagi in the neck. Evidently the inhibitory reflex is mediated by the vagi. We propose to call this the enterogastric reflex. There appears to us to be a rather close analogy between this reflex and the depressor reflex of the heart.

Apparently the same mechanism is involved in the inhibition of hunger contractions by stimuli applied to the intestinal mucosa.[4, 5]

[4] Boldireff, W. N., *Zentralbl. f. Physiol.*, 1904, **18**, 489.

[5] Brunheimer, E. H., and Carlson, A. J., *Am. J. Physiol.*, 1914, **36**, 191.