at time of operation were allowed the longer period (180 days) in which to regenerate. Success in complete removal of the ovary increases as the age at which animals are spayed decreases. This fact leads us to believe that the last word has not yet been said on this subject of mammalian ovarian regeneration, and a further series of experiments based exclusively on very young rats has been initiated.

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[1] Davenport, C. B., *J. Exp. Zool.*, 1925, xlii, 1-11.

[2] Haterius, H. O., PROC. SOC. EXP. BIOL. AND MED., 1927, xxiv, 784-786.

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Regurgitation of Duodenal Contents as Factor in Neutralization of Gastric Acidity.

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Considerable work has been done on gastric function, but this has been mainly concerned with the motor activity of the stomach. Comparatively little has been done on the chemical activity, that is, the method of secretion, the nature of the secretory stimulus, and the variations of the reactions of the gastric contents. We have lacked exact methods for investigating these functions. In the past, the test meals, of many kinds, were used. Inasmuch as results with any one type of test meal vary greatly among individuals who are apparently normal, and also vary so much among patients afflicted with a given type of gastric disorder, the uselessness of this mode of examination is evident. A more exact method has been described by Bloomfield and Keefer,[1] who stimulated gastric acidity with 50 cc. of 7% alcohol to which a small amount of phenolphthalein had previously been added. Here, again, is a method in which an attempt is made to gauge the chemical activity by the amount of free HCl secreted. We know that there are many individuals, free from any gastric symptoms, in whom the HCl content of the stomach varies from a hypochlorhydria to an achlorhydria; on the other hand, most individuals with hyperchlorhydria give symptoms which are referrable to this condition. It seemed to us, then, that conditions such as these in the stomach, were not due to secretory defects alone, but to a combination of secretory and motor

activity. The question then arose, how to measure these, simply and accurately.

In 1914, Boldyreff[2] introduced a certain amount of 0.5% HCl into the stomachs of dogs. This is the concentration at which HCl is normally secreted in the stomach. In the course of an hour or more, the acidity of the fluid decreased and it left the stomach. He thought that this neutralization was due to regurgitation of duodenal contents into the stomach. The strongly alkaline constituent here is pancreatic juice, which, we know, is secreted due to the presence of acid in the stomach. The bile and intestinal juices play minor rôles. Boldyreff proved this by tying off the pancreas and then found that neutralization did not occur. Elman[3] also has shown this to be the case in his animals with pancreatic fistulae. Hawk[4] and his associates have demonstrated this regurgitation of pancreatic juice in the resting stomach by the presence of trypsin in the gastric juice.

We repeated these experiments, introducing 200 cc. of 0.5% HCl into the stomach of an apparently normal dog. Ten cc. were withdrawn for examination every 10 minutes. We found that in the normal animals the titration at any given interval was practically the same. By averaging the results in many dogs we were able to construct a normal curve. Starting with a titration of 140 free HCl (0.5%) the decrease is gradual down to 49 free HCl at 90 minutes. The stomach usually emptied in from 90 minutes to 2 hours. In some of the experiments the fluid in the stomach was withdrawn at the end of each 10 minute period, measured and reintroduced. In many instances the amount withdrawn at the end of a 10 minute period was found to be greater than the amount introduced into the stomach at the beginning of the period. This increase, since it was accompanied by a drop in acidity, was due to the alkaline duodenal contents which had poured back into the stomach. If this increase were secreted gastric juice, there would have been no decrease in acidity. The exact mechanism of this phenomenon is as follows: Acid gastric juice, especially at the concentration at which it is secreted, will not be tolerated by the sensitive duodenal mucosa. Instead, large amounts of alkaline pancreatic juice are secreted and this fluid pours back into the stomach to decrease the gastric acidity to that point at which the duodenum will accept it. The reaction of the gastric contents, then, at any given time in the course of digestion is the resultant of secretion and neutralization by regurgitation. The prepylorus, pylorus and duodenum may well be regarded as a single organ, a mixing chamber where the acid material is prepared for the intestines and it is in

this region that most of the gastro-duodenal lesions occur. We propose the above described method of examination, because it gives us a more or less exact measure of the physiologic activity of this mixing chamber. Unlike most methods of gastric study, we are here dealing with known amounts of known substances.

We next tried the effect of certain operative procedures upon the stomach. First we cut the vagi, either intrathoracically or intraperitoneally, or we severed the intrinsic nerve supply by cutting around the stomach down to the mucosa. Examination of these animals later showed a decreased emptying time, which is what Hughson found in studying the motor function after vagotomy. There was also a more rapid neutralization. This is due to the fact that without vagus control the pylorus loses its tone, is more patulous and allows quicker neutralization. The latter also explains the decreased emptying time.

We next subjected normal animals to either gastroenterostomy, Polya-Balfour resection, or pyloroplasty. In all these instances there is decreased emptying and quicker neutralization, and this is particularly the case following pyloroplasty or resection. The neutralization in the gastro-enterostomy was about the same as after vagotomy.

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[2] Boldyreff, *Quar. J. Exp. Physiol.*, 1914, vii, 1-12.

[3] Elman, Robt., to be reported.

[4] Hawk, *Am. J. Physiol.*, 1916, xxxix, 459.

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Decerebrate Pigeon-Fear Signs

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Based on the statements of Flourens,[1] McKendrick,[2] Ferrier,[3] Vulpian,[4] Schrader[5] and others,[6] it is still believed that the pigeon deprived of its cerebral hemispheres, "exhibits no signs of fear." In the study of such a pigeon,[7] I observed repeatedly, indubitable signs of fear. Some of these signs were: dodging, starting, trembling, fleeing, struggling, staring, and crying out in a characteristic way. Since these signs, which show the semblance of fear, were produced