consumption. The deformation was accomplished by centrifuging the samples with an air driven centrifuge (H. W. Morse's model of the Henri-Huguenard centrifuge) at approximately 75,000 x gravity for from 1 to 10 minutes. Centrifuging for 6 minutes caused a delay of about 12 hours in subsequent growth of the piece, and an immediate reduction in the consumption of oxygen to near 50%. These results indicate that growth and respiration depend upon an intimate association of elements of relatively low and high specific gravity in the plasmodium, that these can be separated by centrifuging to the impairment of growth and respiration. But unlike comminution, the effects of separation by centrifuging are reversible.

7604 P

Influence of Closed Intestinal Loop Strangulation on Volume of the Combined Digestive Secretions.*

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We have reported our findings[1] on the influence of simple duodenal obstruction upon the volume of the combined gastric, biliary, pancreatic, and duodenal secretions. In the present work we have studied the influence of closed intestinal loop strangulation upon these same secretions. Twenty-two fasting healthy dogs were used in the study. All had their salivary ducts ligated.

In the first group of animals the duodenum was divided below the entrance of the lower pancreatic duct, a Dragstedt type of intestinal cannula was placed in the proximal duodenum and the cut ends were inverted. A second cannula was placed in the jejunum about 6 to 8 cm. distal to Treitz' ligament. From the duodenal cannula the combined digestive secretions drained into a clean rubber bag. Collections were made every one to 4 hours day and night, measured, and returned by cannula into the jejunum. About 50 cc. of Ringer's

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[1] Montgomery, M. L., and Swindt, J. M., PROC. SOC. EXP. BIOL. AND MED., 1934, **31**, 915.

solution or tap water were added alternately to the returned secretions. In addition to the fluids mentioned 500 to 1500 cc. of Ringer's solution were given subcutaneously daily to prevent dehydration. The control period lasted from 3 to 7 days. After the animal had fully recovered from the operation and the volume of the secretions had reached a constant level a second operation was performed. The jejunum was divided and the ends inverted just proximal to the jejunal cannula, producing an isolated duodeno-jejunal loop 15 to 20 cm. long around Treitz' ligament. Following this the collections and replacements were made in the usual manner. When replacement of the secretions was impossible larger amounts of Ringer's solution were given subcutaneously. In the obstructive period vomiting occurred. The volume of vomitus was prorated and added to the amounts of secretion collected. In 6 of the 10 animals the results were complicated by the following occurrences: gastric bleeding, perforation of the loop without distention, leakage around the cannula, failure of the secretions to assume a stable level during the control period, and internal hernia obstruction. In 5 of these animals the secretions were diminished in volume after the production of the isolated loop. In the animal with the bleeding into the stomach and duodenum the secretions were increased.

In the remaining 4 dogs the results were free from complications. Two of these were operated on under ether, and 2 under 2% novocaine anesthesia. Only one of the latter 2 had morphine prior to operation. In the control period the secretions reached a level in from one to 2 days averaging from 50 to 70 cc. per hour. Following the obstruction these animals survived for from 2 to 4 days during which time the secretions never exceeded 45 cc. per hour. In each individual instance the volume of the digestive secretions after the production of the isolated loop was definitely less than the volume obtained during the control period. At autopsy these 4 animals showed a distended gangrenous loop without gross perforation.

It was thought that the second operation might have a depressant influence upon the digestive organs. Therefore, in a second group of 12 dogs an effort was made to produce an isolated loop without the second operation. Various methods tried on 8 animals failed. Then in 4 dogs the duodenal and jejunal cannulae were placed as in the first group and an isolated duodeno-jejunal loop was made with a round flanged brass cannula placed by means of 2 purse string sutures into the distal end to drain the loop. During the control

period the collections and replacements of the digestive secretions were made in the usual manner. Then the isolated loop was closed by plugging the drainage cannula with cotton and screwing a cap on the end. In 2 of these animals there was leakage around the cannula which allowed the loop to decompress and prevented strangulation. However, in 2 animals the closure was perfect. The loops became distended, necrotic, and perforated as revealed at autopsy. During the control period the secretions in these 2 animals averaged about 65 cc. per hour, whereas the highest value after obstruction of the loop was 50 cc. per hour. Often it was much lower. One animal showed a sharp terminal rise in secretion, which, however, did not exceed the average for the control period. The character and amount of the immediately preceding secretions indicated this probably was due to terminal relaxation of the pylorus and emptying of accumulated fluid in the stomach rather than to stimulation. In the second dog the stomach was aspirated frequently during the period of obstruction and the terminal rise did not occur. It is our belief, therefore, that in isolated duodeno-jejunal loop strangulation obstruction the combined gastric, pancreatic, biliary and upper duodenal secretions are not stimulated to excessive secretion. On the contrary they tend to be depressed.

7605

Embolism by Air and Oxygen: Comparative Studies.*

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Attempts were made in these experiments to compare the minimal fatal dose of air and oxygen when introduced into a peripheral vein. Van Allen, Hrdina and Clarke[1] found that in embolism due to air introduced into the pulmonary vein, the rapidity of introduction of the air and the position of the animal were 2 factors of prime importance. The position of the animal was believed to be of importance by directing the flow of air upward by gravity. These authors found that when the head was uppermost, the air more easily pro-

* Work done in part under a grant from the Douglas Smith Foundation. Preliminary report.

[1] Van Allen, C. M., Hrdina, L. S., and Clarke, J., *Arch. Surg.*, 1929, **19**, 567