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Electromyographic Studies of Gastro-intestinal Tract. II. Is There a Gradient of Electrical Potential Along the Small Intestine?

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In 1922, Alvarez[1] mentioned briefly studies that led him to suspect that at least in certain animals there might be a gradient of electrical potential along the small bowel with the duodenum negative to the parts distal to it. Unfortunately the technic was not entirely satisfactory and at times the gradient was not evident, so the subject was left open for further research.

In the experiments here reported an effort has been made to get definite information with a more reliable technic. Rabbits, anesthetized with urethane and with the abdomen open, were placed in a wooden tank filled with physiologic salt solution at 37°C. The thermostat and the heating element were enclosed in glass. Under these conditions there was no obvious source of electrical potential that could set up stray currents. To make sure of this it was determined experimentally that the bath was everywhere at equal potential.

Some mineral oil was floated over the saline solution and the loops of intestine being studied were allowed to float up into the non-conducting layer. In order to avoid possible changes in potential due to the presence of material in the lumen of the bowel, the gut was washed through with physiologic salt solution. A non-polarizable silver-silver-chloride electrode was left attached to the duodenum near the pylorus and differences in potential at various points along the bowel were measured with the help of another electrode of the same type. The differences were measured with the calibrated control board of an electrocardiographic apparatus. When so used it becomes a sensitive potentiometer with the string galvanometer as the null instrument. Readings were made to the nearest millivolt.

Observations were made on 10 rabbits. First measurements were made at about 10 successive points on the intact small bowel. The gut was then excised, and its lumen was again washed through with

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[1] Alvarez, W. C., and Mahoney, Lucille J., *Am. J. Physiol.*, 1922, **58**, 475.

saline solution, similar measurements were made at the same points, identified by markers. In Fig. 1 are presented the results of the

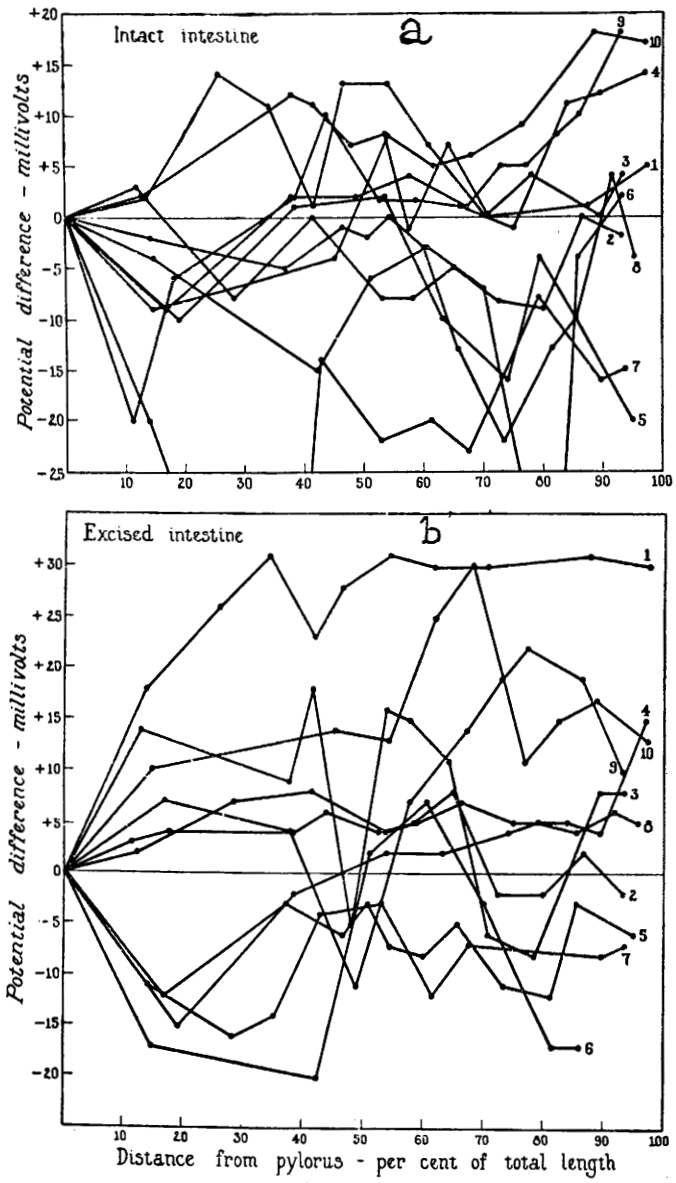

FIG. 1.

Potential differences measured with reference to the pylorus for different points along the intestine. The distance of the point, measured from the pylorus is expressed in % of the total length from pylorus to tip of appendix; *a*, the intestine intact in the animal, each numbered curve is for an individual animal; *b*, the intestine excised, the numbers correspond to those in *a*.

individual observations, and in Fig. 2, the averages. It will be seen that, both in the intact and the excised bowel, there was no uniform trend of potential along the bowel.

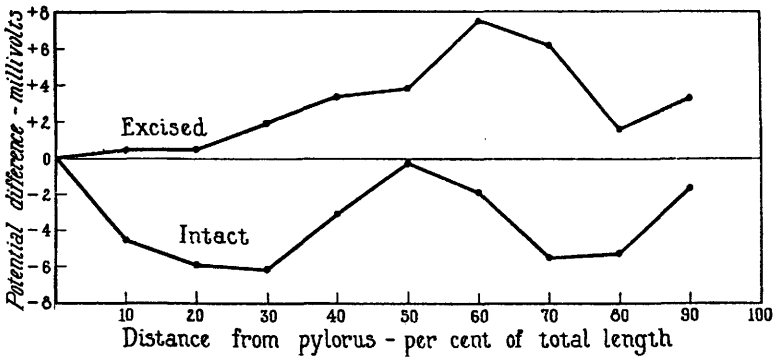

FIG. 2.
The averages for the 10 experimental animals shown in Fig. 1.

Considering the marked individual variability it was rather surprising to find a high degree of parallelism in the mean values obtained with intact and excised bowel. As one might anticipate from Fig. 2, the correlation between the potential values obtained from the same point of the intact and excised intestine was significantly high. The coefficient for the entire series of observations was $+0.55 \pm 0.05$.

It is impossible to say what significance these observations have. All we can say is that whatever the factors are which determine the potential difference between any 2 parts of the bowel they tend to remain more or less constant at least for a short time after the removal of gut from the animal.

Summary. There is no constant gradient in electrical potential along the small bowel of the rabbit. The values that are found tend to persist for a while after excision of the bowel.