If the posterior splanchnic nerves are sympathetic as Müller and Liljestrand (1918) describe them to be, the inhibitory action of adrenaline on the rectum is also an exception. Such exceptions indicate that a physiological distinction between parasympathetic and sympathetic can not be made, and that the effect of adrenaline is not always the same as that of stimulation of the sympathetic system.

16. PERISTALSIS IN MYXINE

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Dahlgren and Turnball have studied the intestine of Myxine histologically and found (to quote Turnbull) "little or no muscle in the intestinal wall of Myxine . . . Peristalsis is carried on by the muscles of the body wall. In order that this may be possible, the small digestive tube is padded with a layer of large-celled connective tissue, kept expanded by turgidity. These connective tissue cells increase the diameter of the intestine so that it almost fills the body cavity and so brings the intestinal walls close enough to the body wall that the peristaltic action of the latter may be transmitted to the former."

The intestine of Myxine is a straight tube of large external and small internal diameter—running from mouth to anus and lying very close to the body wall, which is heavily muscled and capable of great activity.

From this study it was concluded that the intestine in no wise aids food in its passage through the body.

Work was done by me on live material to verify the histological results. It was found to be impossible to study the movements of the intestine satisfactorily *in situ* in the living animal. These creatures are extremely active and the wriggling, squirming movements of the body wall are of course, directly transferred to the intestine, which lies in immediate contact with it. To obviate this difficulty, the intestine was studied in two ways after removal: first, by direct observation; and second, by kymograph records. In both cases the intestine had to be immersed in a fluid medium similar to the blood and for this purpose, a solution was made based on figures of the analysis of Myxine blood made by Dr. E. K. Marshall, to wit:

NaCl	.30 gm.
KCl	.075gm.
$CaCl_2$	.10 gm.
$NaHCO_3$	.10 gm.
Distilled water	1000.0 gm.

Muscle tissue immersed in it could be kept alive for long periods of time.

In the method of simple observation, the muscle was cut in sections about three or four centimeters long and placed in watch glasses. The tissue was stimulated by painting with a small brush saturated with the stimulant. A solution of barium chloride, one part in twenty-five was found to produce strong contraction. This contraction was relived by painting with a tenth per cent solution of atropin. Pinching the muscle produced contraction, but not in such a marked fashion as it did in the sculpin. Then a piece of muscle was placed in a dish of salt solution for one minute and transferred to a Ringer's solution. Here true peristalsis was observed and in this observation the writer was confirmed by Dr. Brenton R. Lutz. This same effect was produced several times. The indentations were not large; if the intestine were eight mm. over all, the identation would not exceed .8 mm on a side.

For the second method the muscle was arranged on a system so that the contractions would register a rise on the surface of a slowly revolving, smoked drum. A piece of muscle roughly two cm. was used—suspended sometimes lengthways, sometimes crossways so that the pull of the circular muscles was directly transmitted. This latter method was the more effective. With the muscle arranged thus, a solution of barium chloride would produce curves of contraction the height of which was as great as 1.2 cm. These were the curves of immediate contraction, not at all peristaltic in nature. They indicated quite simply that the muscle possessed the power of contraction. Sculpin intestine under the same treatment rose only 2.0 cm. so the contractions of Myxine are easily comparable. That these contractions were not due to mere physical effect of the salt solution was demonstrated by using a piece of freshly killed muscle. No such contraction occurred.

For the purpose of comparison, the intestine of the common eel (an intestine also uncoiled and quite straight) was used. Quantitatively, the contractions produced by Myxine were easily comparable. As far as the rhythmic contraction is concerned, this was produced in Myxine by handling the intestine roughly while mounting it on the apparatus. The contractions so produced were (from crest to trough) one and a half to two mm. The same treatment with sculpin produced a smooth sine curve with a crest to trough distance of some four mm. Other stimulants were tried on both sculpin and Myxine. 1. Adrenalin 1:5000 and 1:3000 produced no effect in either case; 2. Atropin, one tenth per-cent, produced profound relaxation in both muscles; 3. Nicotine, 1:1000 and 1:5000 produced rhythmic contraction after loss of tone in sculpin and mere fall in tone in Myxine. The stimulation produced by the use of the various salts seemed the most effective.

Histological study in an effort to find nerve plexuses such as those of Meissner and Auerbach, have been as yet unsuccessful, but it is hoped

that these plexuses will become evident as soon as difficulties in technique are overcome.

From the study of the kymograph records secured, however, one is moved to doubt the statement of Turnbull, viz., that no muscle was found present in the tissue and in any case, there was not enough to be of any functional value. Such contractions as are described above are strongly indicatory of muscle. The peristalsis observed by Dr. Lutz and the writer would seemingly point to the same conclusion. However, from the facts: first, that the peristaltic action is quite weak; and second, that the walls of the intestine are seemingly weak and flabby, it may be that actual movement of the food downward is not the chief function of the muscle found present. It may be used for a process described by Cannon as *segmentation*. The process of segmentation seems to divide the bolus of food into smaller and smaller boli, thus increasing both the absorbtive and secretive area of contact between the food and the intestinal wall. But, *en tout cas*, be it for segmentation or for peristalsis, it would appear that muscle is present and more or less functional in the intestine of Myxine.