

tested for phage in the usual manner. For the bacterial proteolytic enzymes, a Berkefeld filtrate of a 4-day culture of *B. pyocyaneus* in synthetic medium was used in the same manner as the bacteriophage. The test for the presence of the proteolytic enzyme was by inoculating the filtrate and suspended precipitate into carbol-gelatin, incubating at 37°C. for 48 hours, placing in the icebox for 1 hour, and then observing for liquefaction.

Table I shows that the bacteriophage and the proteolytic enzyme are completely precipitated by these azin and thiazin dyes, and that the other basic dyes used do not completely remove the phage or the enzyme from solution. With the exception of pyronin the dyes had little if any inhibiting action on either the phage or the enzyme. In the case of the pyronin the inhibiting action was considerable for both.

This inhibitory action has not been investigated. It may be due to the photodynamic action of the pyronin. But some of the other dyes are photodynamically active and showed no such effects; further, *coli*-phage, unlike the staphylococcal phage, is not sensitive to oxidation.

The nature of the union of phage with the dye is unknown. If it is an adsorptive phenomenon one could expect that all the dyes of the same charge and relative molecular size would act in the same manner.

Marston believes the union of trypsin and pepsin with the azin dyes to be a chemical reaction.

The chemical union of bacteriophage and dye, if proven, would be another indication of the chemical or nonliving nature of the bacteriophage.

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#### **Preganglionic Connections of the Intramural Ganglia of the Urinary Bladder.**

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The pelvic autonomic ganglia including the intramural ganglia of the urinary bladder, are connected with the lower thoracic and upper lumbar segments of the spinal cord through the splanchnic and hypogastric nerves and with the sacral segments through the pelvic nerves. The efferent fibers which enter the pelvic plexus on

either side via the hypogastric nerve are mainly postganglionic sympathetic fibers, but include some preganglionic fibers of the thoraco-lumbar outflow. According to Langley and Anderson (1894, 1896)<sup>1</sup> and Stewart (1899)<sup>2</sup> some preganglionic fibers which enter the inferior mesenteric plexus do not terminate in this plexus but extend distalward in the hypogastric nerves. In spite of these reported observations, the pelvic autonomic ganglia quite generally have been regarded as related mainly to the parasympathetic division of the autonomic nervous system.

In an experimental anatomical study of the preganglionic connections of the ganglia in the pelvic plexus in the cat, Kuntz and Moseley (1936)<sup>3</sup> have demonstrated that some of these ganglia receive preganglionic fibers exclusively through the thoraco-lumbar outflow, some exclusively through the sacral outflow, and some through both the thoraco-lumbar and sacral outflows.

In the present study, cats have been used as the experimental animals, and the following operative procedures have been carried out under aseptic conditions. In one series, the pelvic nerve was sectioned bilaterally near its origin from the sacral nerves in order to insure degeneration of all preganglionic and visceral afferent sacral nerve components which enter the urinary bladder. In another series, the inferior mesenteric ganglia and both sympathetic trunks from the second lumbar segment caudalward were extirpated in order to insure degeneration of all preganglionic components of the thoraco-lumbar outflow which might reach the urinary bladder. When the animals were killed 18 to 24 days after operation, the urinary bladder was prepared for study by the pyridine silver method.

Preparations of the bladder taken from animals which have been subjected to section of the pelvic nerves show fiber degeneration in some of the intramural ganglia but not in others. In some ganglia, all the fibers except those of local origin have undergone degeneration; the intercellular plexuses formed by the preganglionic fibers which terminate in relation to the ganglion cells are absent. In some, the intercellular plexuses are absent in certain areas but present in others. In some, no evidence of fiber degeneration can be detected.

Preparations of the bladder taken from animals which had been

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<sup>1</sup> Langley, J. N., and Anderson, H. K., *J. Physiol.*, 1894, **17**, 177; *ibid.*, 1895, **20**, 372.

<sup>2</sup> Stewart, C. C., *Am. J. Physiol.*, 1899, **2**, 182.

<sup>3</sup> Kuntz, A., and Moseley, R. L., *J. Comp. Neur.*, 1936, **64**, No. 1.

subjected to extirpation of the inferior mesenteric ganglia and both sympathetic trunks from the second lumbar segment caudalward also show fiber degeneration in some of the ganglia but not in others. In some ganglia, all the fibers except those of local origin have undergone degeneration. In some, the intercellular plexuses have undergone degeneration in some areas but not in others. In still others, no evidence of nerve fiber degeneration can be detected.

The ganglia in which intercellular plexuses undergo degeneration following extirpation of the inferior mesenteric ganglia and the sympathetic trunks from the second lumbar segment caudalward obviously receive preganglionic fibers via the thoraco-lumbar outflow. Those in which intercellular plexuses undergo degeneration following section of the pelvic nerves obviously receive preganglionic fibers via the sacral outflow. Those which show degeneration of the intercellular plexuses in only a portion of the ganglion, after either type of operation, receive preganglionic fibers from both the thoraco-lumbar and sacral outflows. The findings set forth above, therefore, warrant the conclusion that some of the intramural ganglia of the urinary bladder receive preganglionic fibers exclusively via the thoraco-lumbar outflow; some exclusively via the sacral outflow, and some via both; consequently, they include sympathetic, parasympathetic and mixed ganglia.

Quantitative determinations of the sizes and distribution of the ganglia of these three types have shown that approximately 40% are parasympathetic, 40% sympathetic and 20% mixed. The parasympathetic ganglia on the average are larger than the sympathetic ganglia and are situated more superficially in the bladder wall, being located mainly in the adventitia and the outer zone of the musculature. The ganglia located more deeply in the musculature are predominantly sympathetic. Although the ganglia are most abundant in the trigone, particularly in proximity to the ureters, those within this area make up only 50% of the intramural ganglia and include parasympathetic and sympathetic ganglia in approximately equal numbers. These findings do not substantiate the conclusions of Iljina and Lawrentjew (1932)<sup>4</sup> and Polykarpowa (1935)<sup>5</sup> that the intramural ganglia of the urinary bladder are exclusively parasympathetic.

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<sup>4</sup> Iljina, W. S., and Lawrentjew, B. J., *Ztschr. f. mikr. Anat. Forsch.*, 1932, **30**, 543.

<sup>5</sup> Polykarpowa, A., *Ztschr. f. Anat. u. Entw.*, 1935, **104**, 378.