

LXXXI. FURTHER NOTES ON THE MECHANISM OF THE TRANSMISSION OF PLAGUE BY FLEAS.

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(With Plates XXXV and XXXVI and 2 Text-figures.)

SINCE the publication of the paper dealing with this subject (Bacot and Martin, 1914) further material in the form of longitudinal serial sections of infected fleas has passed through my hands. An examination of this material confirms the conclusions already arrived at, and adds one or two fresh details to our knowledge of the subject.

Text-figures 1 and 2 show the proventriculus in section and serve to illustrate the action of the opening and closing of the valve formed by the chitinized spine-like epithelial cells. When at rest the position of the spines and shape of the organ is shown in fig. 1—the opening into the stomach being free for the passage of blood. On the contraction of the muscular bands, which are arranged like the hoops of a barrel, the

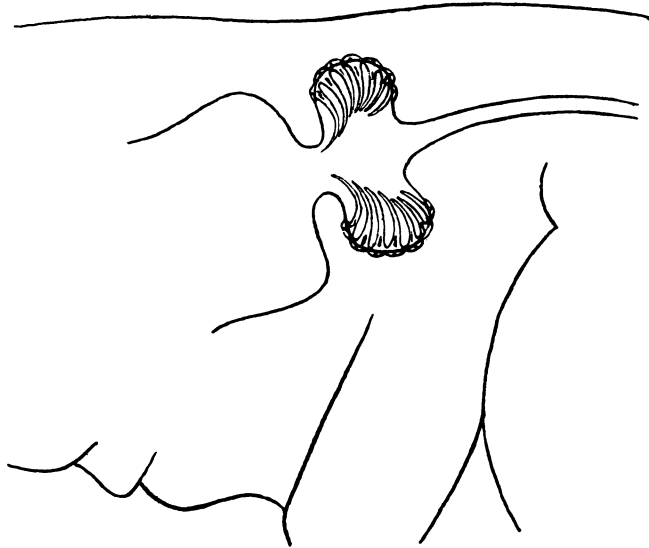


Fig. 1.

girth of the proventriculus is constricted; the organ is by the same action elongated, and the lumen of the opening into the stomach is closed against the outward passage of blood (fig. 2).

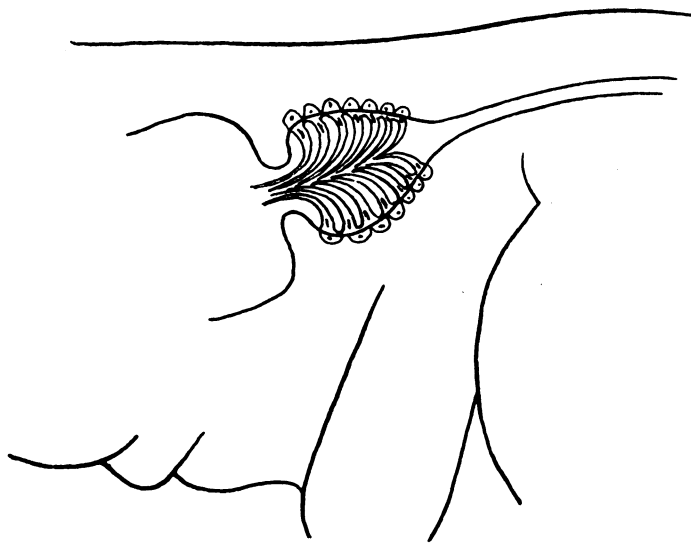


Fig. 2.

As already pointed out, it is the lodgment and growth of the bacilli among the spines of the proventriculus that is the initial stage of the blockage which during a subsequent feeding-act may lead to regurgitation of infected blood into the wound caused by the flea.

From the later sections it appears quite definite that in the first instance the block may be of a quite ephemeral nature—a second stratum forming in front of the first, both being so slight as to be depressed by the pressure of fresh blood entering through the oesophagus. When, finally, the process develops to the extreme stage shown in figure 4, Plate XXV, of the above-quoted paper, the condition is not necessarily fatal to the flea. The section of a specimen of *Ceratophyllus fasciatus*, Plate XXXV, fig. 1, shows the clearance of a passage through the centre of such a plug. The rupture of the obstructing mass does not, however, restore the lost valvular function to the proventriculus, but merely leaves a passage through which the blood can flow out of the stomach just as freely as it enters. The result, as is shown in this particular specimen, is that, after a full meal, blood, impregnated with bacteria, extends from the posterior portion of the stomach to the anterior chamber of the

pharyngeal pump. In this condition the infection of any animal on which the flea fed would seem to be more, rather than less, likely than in the case of a flea in which the proventriculus is completely blocked. With the existence of a patent proventricular valve the infected contents of the stomach may, owing to the peristaltic contraction of that organ, be regurgitated into the wound on the cessation of the suction of the pharyngeal pump.

Other sections show fresh unaltered blood in the sucking tube of blocked fleas, indicating that there is sufficient pressure in the distended oesophagus to prevent the normal clearance of the tube after a meal, which should take place owing to the action of the pump. One example shows the presence of a massive infection of such fresh blood along the course of the oesophagus to the pumping chamber, extending well down into the upper third of the sucking tube (see Plate XXXVI).

REFERENCE.

BACOT AND MARTIN (1914), Observations on the Mechanism of the Transmission of Plague by Fleas. *Plague Supplement III*, January 14, 1914, pp. 425—9.

DESCRIPTION OF PLATES.

PLATE XXXV.

Fig. 1 is a diagrammatic representation of a longitudinal section through the oesophagus (*oe*), proventriculus (*p*), and stomach (*s*) of a heavily infected specimen of *Ceratophyllus fasciatus*. The light shaded portion shows where fresh blood, impregnated with free individuals of *B. pestis*, is present in the specimen, the darker shading indicates the solid mass of bacteria which has so far become disintegrated at its centre, as to be ruptured by the force of the blood pumped into the oesophagus, thus allowing the passage of blood to the stomach. The action of the valve is, however, inoperative, owing to the solidity of the mass of bacteria in which the spines of the proventriculus are embedded. × about 180.

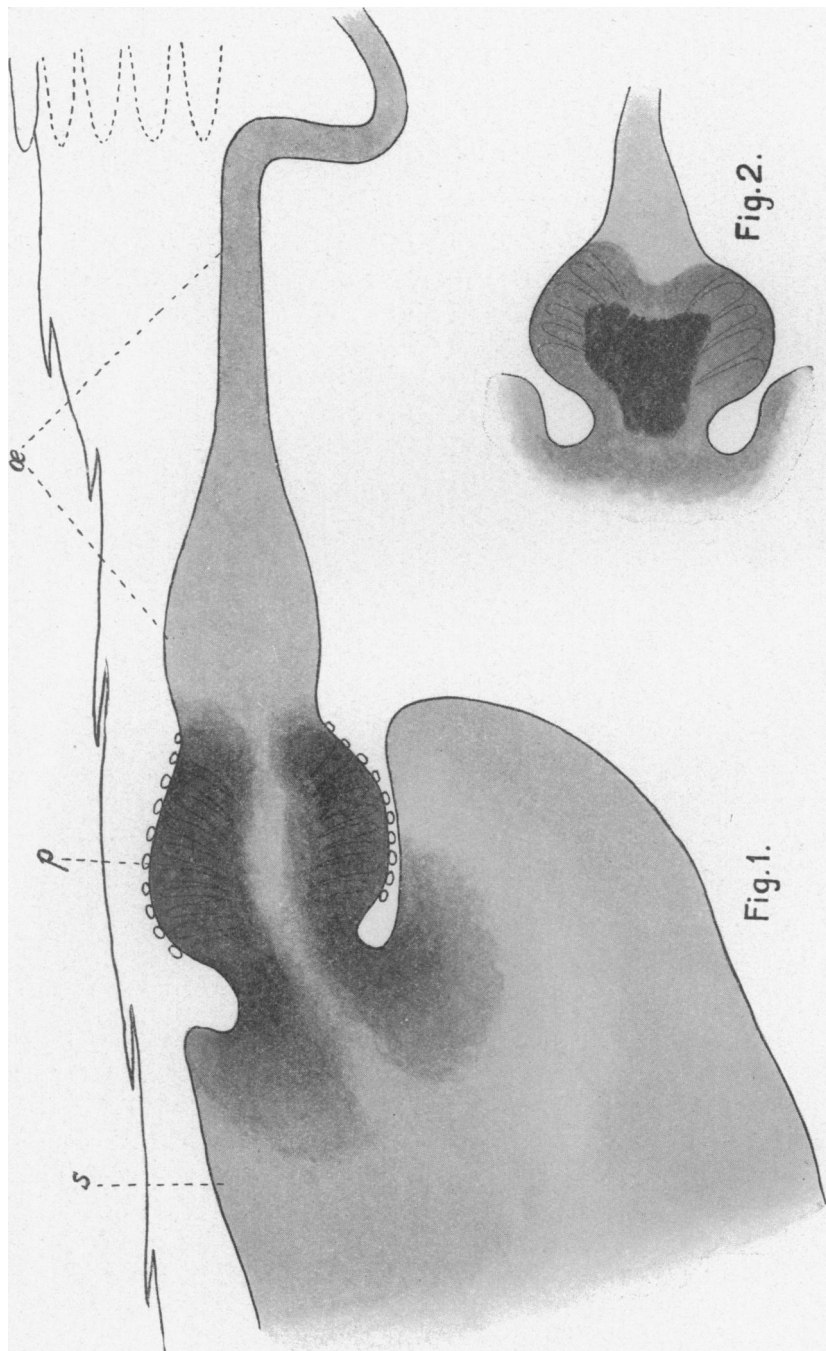
Fig. 2 shows a similar representation of a section through the dissected proventriculus and oesophagus of a specimen of *C. fasciatus*. It differs from fig. 1 in that the lumen of the valve is still obstructed by the disintegrating mass of an old plug and that the growth of bacteria surrounding this, which is of more recent growth, though yielding to the pressure of the fresh blood pumped into the oesophagus, has not yet been ruptured. × about 180.

PLATE XXXVI.

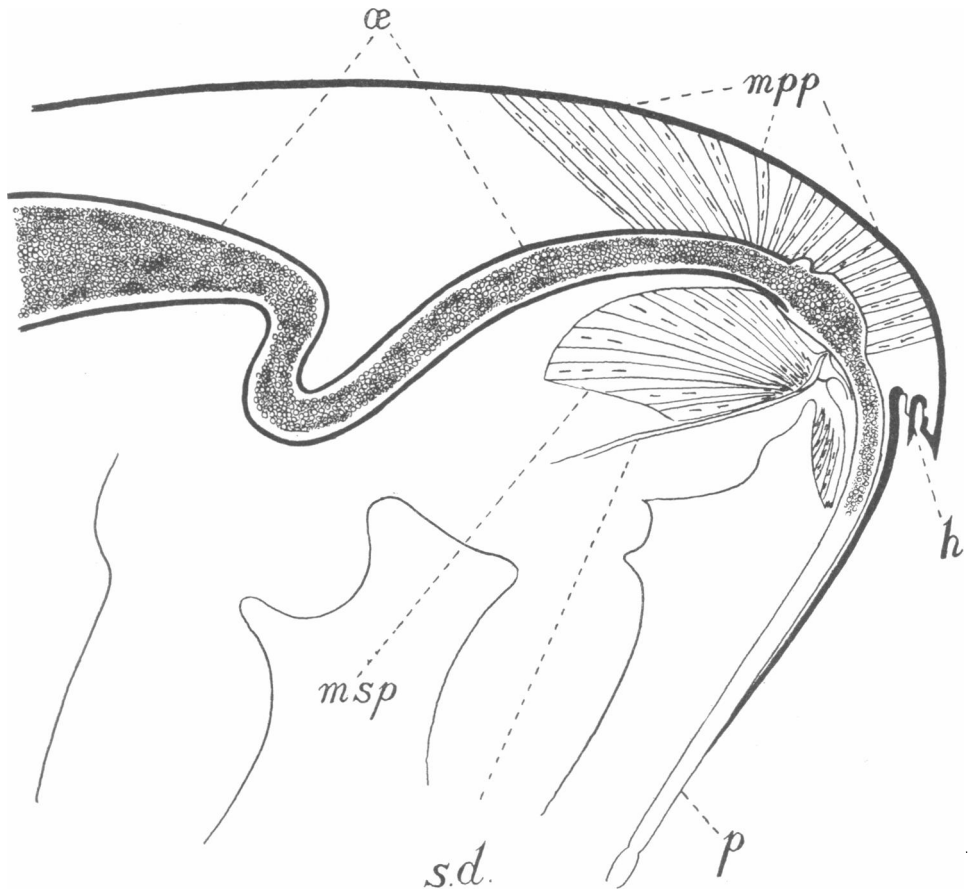
Longitudinal section of head and thorax of a blocked specimen of *Ceratophyllus fasciatus*. × about 250.

h., arrangement of chitinous and soft integument in juxtaposition, forming a hinge which allows of the free ventro-dorsal movement of the sucking tube. *m.p.p.*, muscles of pharyngeal pump. *m.s.p.*, muscles of salivary pump. *oe.*, oesophagus containing a mixture of blood and bacilli. *p.*, proboscis or sucking tube. *s.d.*, salivary duct.

NOTE.—The bacilli are better seen with the aid of a reading lens.



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