JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

AUGUST 1892.

TRANSACTIONS OF THE SOCIETY.

IX.—*Note on the Process of Oviposition as observed in a Species of Cattle Tick.*

By R. T. LEWIS, F.R.M.S.

(Read 18th May, 1892.)

PLATE VII.

DURING the past six months I have occasionally received from a correspondent in Natal a number of specimens of the Tick family, together with such information as he has been able to gather concerning their habits of life, his main object being to elicit such further information as might be of use in indicating the most probable direction in which some satisfactory means of dealing with this serious pest might be found. From his reports it would appear that the injury

EXPLANATION OF PLATE VII.

The eight figures given represent the anterior extremity of the tick during the process of oviposition, from a point of view directly in front of and slightly above the marginal line—scale $\times 14$ —image erect. The arched portion at the top of each figure is the margin of the inflexible dorsal plate, below which is the depression produced by the retraction of the head*—the palpi and rostrum alone being visible. Surrounding this depression on its three other sides are the parts drawn over from the softer ventral surface by the same action. The first pair of legs are seen—one on either side—extended in an upward direction, the ovipositor is below and between them.

- Fig. 1 shows the parts referred to, at the commencement of the process.
„ 2, the first appearance of the membranous sac above the head, the ovipositor extending, and the palpi separating.
„ 3, the same, further developed.
„ 4, the position of the parts immediately prior to the extrusion of the egg.
„ 5, the same, immediately after.
„ 6, the membranous body enveloping the egg.
„ 7, „ „ being withdrawn.
„ 8, the removal of the egg by the palpi.

* The word “head” here and throughout the paper is used in its ordinary and popular signification. As pointed out by Mr. Michael at the meeting (see p. 447) in *Ixodes* there is no true head, the part usually so designated being in reality the rostrum, a term often restricted to the projecting portion made up of the maxillary lip and the sheaths containing the mandibles.—R. T. L.

inflicted by these creatures upon domestic animals, especially horses and cattle, can hardly be overstated, and a microscopic examination of the structure of their mouth-organs leaves no doubt as to their natural capabilities for producing all the mischief laid to their charge. That they are often found in immense numbers upon ill-tended animals is a fact well known to stock-keepers in warm climates: but, although much has been done in the investigation of their minute structure, there still remain some missing links in their life-history, one of which it is hoped to supply by the following note.

All observers are agreed that when full grown and full fed the adult female tick voluntarily quits the animal upon whose blood it has been subsisting, and dropping off upon the ground, makes its way at once to the grass, amongst which it lays innumerable eggs, and dies. In favourable weather the eggs are said to hatch in about a fortnight, but what becomes of the young larvæ, or how they contrive to exist until opportunity arises for attaching themselves to some passing animal, is one of the points which remains to be cleared up; certain it is, however, that their habit is to ascend the grass-stalks in large numbers, there to await a passing chance of transference, and persons who walk amongst grass at the season when they most abound are sure to return with lively remembrances.

Early in November last I received by post a small consignment of various Cape insects, and inclosed with them was a cattle tick of larger size than any I had hitherto seen, its length on arrival being rather over $3/4$ in., and its weight 25 grains. My correspondent stated that it was not of a kind usually found in the interior of the colony, but that it had been taken from an ox recently brought up from the coast; it was sent off on October 13th, at which time it was said to have weighed 40 grains, though then much less distended than when captured about thirty-six hours previously. It had apparently beguiled the tedium of the voyage by laying a quantity of eggs; but, though torpid when unpacked, the warmth of the room soon revived it, and within an hour it was walking about the table, using, however, three pairs of legs only for the purposes of locomotion, and continually waving the first pair in the air in the same manner as an insect does its antennæ. It has not been easy to determine with certainty to what species this specimen belonged; size and colour, both being variable to a remarkable extent in the same individual under different conditions, cannot be greatly relied upon; but a comparison with such descriptions and figures as have been available leads to the conclusion that it is probably *Amblyomma coronatum*, the more common species, which nearly equals it in size, having been identified with *Amblyomma Hebræum* of Koch. Having been carefully examined, weighed and sketched, this tick was placed in a glass-covered box, where it remained for several weeks in a state of inactivity, except at times, when for purposes of exhibition it was taken in the hand or warmed by the fire; but early in December I noticed that the anterior portion of the ventral surface

had changed in colour from the original chocolate to a dark purple, and on the following morning about fifty eggs were found agglomerated in a heap in front of its head,* with several adherent to the margin of the hard dorsal plate, which appears to represent the upper portion of the cephalothorax in Spiders. These eggs—which were of a deep brown colour, bluntly oval, and measuring .6 mm. long by .45 mm. broad—were transferred to a glass tube in the hope that they would in due course hatch. The tick being replaced in the box repeated the proceeding two days later, the eggs being, as before, heaped in front of the head, but this time connected to the dorsal plate by a continuous chain adherent to it and to each other. It seemed clear that some such observation in the case of the Dog Tick—*Ixodes Ricinus*—had originally led Chabrier to form the erroneous opinion that the eggs were laid through the mouth, with the minute structure of which he was apparently unacquainted. The observations of Frisch on the same subject, though nearer the truth, were scarcely more conclusive—his assertion being that in laying her eggs the female gives out a clear fluid from her mouth for fixing the eggs to her body, for which purpose she advances them to her mouth when laid—because special precaution previously taken enabled me to say with certainty that the creature had not changed its position during the process in the slightest degree. A few evenings later, whilst examining the tick with a view to clear up the point, I noticed again the change of colour before mentioned, and hoping that it might portend a repetition of the proceedings, I placed it in an upright position in such a way that I could observe it under the Microscope with a low power. The head was much retracted, and I perceived for the first time that a deep cavity was formed between the upper side of the head and the under surface of the dorsal plate, the bottom of which seemed to be filled with mucous matter kept in a state of disturbance as if by the movement of something beneath its surface. Unfortunately the creature by some means overbalanced, and falling from the cell upon the table, abruptly terminated the observation. The next evening I specially contrived a cell to meet the requirements of the case, by means of which the tick was not only safely supported on end without fear of dislodgment, but could also be rotated without vibration whilst under the Microscope; nothing else was observed that night, but on the following morning about thirty eggs were found to have been laid, most of which were adhering to the front margin of the dorsal plate.

Disappointment at having again been foiled acted, however, only as an incentive to increased vigilance, and being determined to see the process, if anyhow possible, it was resolved to keep the tick under continuous observation throughout the next day, and night, if needful. It was therefore placed in the rotating cell with the light and warmth of a paraffin lamp converged upon it by a bull's-eye condenser in such

* See note following the "Explanation of Plate."

a way that it could be freely examined in the large field of a Kellner eye-piece through a tripod Microscope placed over it and fitted with a 3-in. objective.

During the somewhat tedious watch, which commenced at 8.30 a.m. on December 15th, I was relieved at intervals by my daughter, whose scientific training and skill as an observer rendered her on this occasion a valuable assistant. For many hours nothing of importance was noted beyond occasional alterations in the position of the front legs and palpi, of which sketches were made as required. But about 5 p.m. some very distinct changes began to take place; the head, which had all along been much retracted, was now so much further withdrawn that the extended rostrum and palpi retreated considerably within the marginal line, and in thus producing the deep depression in which the head was now nearly buried, the cavity between the head and the dorsal plate was again formed, whilst the softer adjacent portions of the lateral and ventral aspects were drawn inwards until that part which had previously been on the ventral surface between the basal joints of the first pair of legs was so far drawn over the margin as to point in an upward direction, when the creature was standing in its natural position. Whilst this was going on, the parts surrounding this depression underwent marked changes of colour, passing from brown to blue, and ultimately fading to a dull chrome-yellow, a well-marked white vesicle at the same time appearing upon the slightly elevated centre of the lower internal wall (fig. 1). About 6 p.m. the head was slowly lowered until the rostrum touched the under surface of the depression, the palpi being at the same time separated, so that one rested on each side of the white vesicle. This movement of course proportionately increased the width of the cavity between the head and the dorsal plate and enabled me again to see the motion I had observed on the previous night. In a few moments it was obvious that a delicate membranous body, glistening with mucus, was being protruded from the cavity (fig. 2), and at length, by a series of convulsive movements it was developed first as a mobile sac, from the lateral extremities of which two elevations were thrown up (fig. 3), in turn to be lengthened by evagination into two processes or papillæ which extended downwards more than half-way across the depression, the whole forming a kind of open receptacle something like that of the two hands of a person when placed together with the wrists in contact for the purpose of catching a ball (fig. 4). At the same instant the before-mentioned vesicle became elongated until it met and was embraced on either side by the papillæ; through its semitransparent walls an egg was seen in motion, which having been delivered into the grasp of the papillæ (fig. 5), the ovipositor at once retracted. This done, the papillæ closed over the new laid egg (fig. 6), and by a series of movements which can best be likened to the actions of the hands during the process of washing with a ball of soap, rapidly covered it with a coating of albuminous secretion, and

then withdrew (fig. 7) from sight, leaving the egg suspended by one end from the under surface of the dorsal plate. The palpi came next into operation, slowly closing together until in lineal contact with the rostrum, the elevation of the head brought their spoon-like terminal joints into contact with the egg, a continuance of the motion effectively cleared it out of the depression (fig. 8), left it adhering to the outer margin, and the process was complete. The head was then again depressed, the palpi resumed their former position and the series of operations which I have attempted to describe were exactly repeated, each successive egg displacing but adhering to the one which preceded it until a chain was formed, and ultimately on reaching the ground a heap resulted such as I had so often seen and puzzled over. The procedure once established went on uninterruptedly, giving us ample time to make careful notes and sketches, and to call in other witnesses of a series of rhythmical movements which at last seemed to fascinate the attention in the same way as is sometimes experienced by watching the cycles of a complicated piece of automatic machinery. The mean of many observations showed that the entire process of laying each egg occupied a period of 2 minutes 42 seconds, but after watching with great interest for upwards of 2 hours, during which we saw about 50 eggs laid without the least hitch—in one case only excepted—the accumulated pile began so far to obstruct the view that I ventured to remove it by lightly touching with a needle. The result of this interference was the immediate cessation of the process, in the course of a few minutes the normal colour of the parts was restored, the head was again protruded, and from that time to the day of its death about two months later not another egg was laid. Whatever may be the precise nature of the fluid with which the eggs were coated, it appears to possess the property of retaining its viscosity for a long time without becoming hardened by exposure to the air, so that eggs put into a tube readily become agglomerated into a ball by contact with each other, yet so lightly that the mass falls easily to pieces if lifted with the forceps, but as easily re-forms on being once more shaken together. Its possible use may be to afford additional protection from the heavy rains common in the regions where ticks do most abound, the slight cohesion affording but little obstruction to the escape of larvæ hatched out from the middle of the mass. The eggs themselves are not easily injured by pressure, having very tough elastic envelopes which explode with a smart crack when thrown upon the fire. I did my best to hatch out those laid by the tick which forms the subject of these observations, but though kept at an even temperature by being carried in the pocket for three months they all eventually flattened and collapsed, from which I concluded that they must have been unfertilized. On repeating the experiment with a quantity of similar eggs laid by the more commonly known "Great Cattle Tick," identified by Mr. Bairstow as *Amblyomma Hebræum*, and coming from the same district, I succeeded in hatching out a

brood to be numbered by thousands. These have afforded an unlimited supply of extremely interesting microscopic objects, but it is perhaps needless to say that every precaution has been taken to guard against the escape of those not required for mounting.

It has been remarked by my friend that if an overgorged tick drops of its own accord from a horse upon the dusty road it at once makes direct for the grass, leaving a characteristic and well-marked track at right angles to the roadside; but if on the other hand a tick is forcibly removed from the animal and thrown upon the road, it goes by a straight line back to him again. Eyes being mostly absent, a query arises by what sense is it so unerringly directed. In 1881 it was observed by Dr. G. Haller, "that near the hind margin of the terminal joint of the first pair of feet in *Ixodes Ricinus* there are two foramina which are covered by a transparent membrane, within which are found chitinous hairs and otoliths, presenting an extraordinary resemblance to the auditory arrangements of the Crustacea."* An organ similar to this, but furnished with a ring of external sensory hairs, is found likewise situated on the front legs of these cattle ticks, being quite distinct even in their earliest stage as soon as hatched, but I have observed that whereas in the larval condition, when possessed of six legs, all are used for purposes of locomotion, when the adult stage is reached and an additional pair of legs is acquired, the second, third, and fourth pairs only are employed in walking, the first pair being entirely withdrawn from the ground by the altered shape of the anterior portion of the body, and thenceforth kept in constant movement waving to and fro above and in front of the head as if they had taken upon themselves the functions of antennæ. The existence of a pair of sensory organs on the terminal joints of the palpi is more obvious, and is seen in the figures of most writers on the subject.†

* This Journal, 1881, p. 449.

† For observations confirming those recorded in this communication, see the Report of the Proceedings of the Society at the June Meeting (*postea*, p. 574).