THE INCUBATION PERIOD OF THE EGGS OF *HAEMATOPINUS ASINI*.

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INTRODUCTION.

THREE kinds of lice are found on horses, two belonging to the Mallophaga or scale-eating lice and one to the Siphunculata or blood-sucking lice.

Of these, one, *Trichodectes equi*, is not very commonly found; whilst the other two, *T. pilosus* and *Haematopinus asini*, have both been common on the horses and mules of the Home Forces during the war. *T. pilosus* was found in about 10 per cent. of the total cases, usually as a mixed infestation, and chiefly in remounts from America or other places abroad, where the transport entailed a long sea voyage.

Of the two latter kinds *H. asini* is the more important because:

- (a) It occurs more frequently.
- (b) The irritation produced by it is greater.
- (c) Constitutional disturbances are set up in grossly infested cases to such an extent that a loss of condition progressing eventually to absolute emaciation is produced.
- (d) The possibility exists of this insect acting, like so many other blood-sucking parasites, as a carrier of disease, although hitherto no disease of horses has been definitely traced to it.
- (e) Lastly, it offers far greater obstacles to lasting eradication than do either *T. equi* or *T. pilosus*, and one of the most annoying features of infestation by this parasite is the tendency of apparently cured animals to become reinfested after the lapse of a few weeks.

In view of the foregoing considerations, experiments were conducted only on the eggs of *H. asini*, and the following remarks apply only to that species.

Most of the dressings in common use in veterinary practice for the treatment of lousiness in horses will, if carefully applied, suffice to kill all living parasites, although the latter are capable of surviving treatment with many *supposed* lethal substances, and in particular seem to enjoy a truly remarkable immunity to arsenic, mild doses of which exert only a stupefying effect. The nits or eggs, however, are extremely resistant, and no dressing at present in use can be relied on to devitalise these with certainty, even the most efficient agent tested allowing 2 per cent. to hatch after five minutes complete immersion.

The experiments herein detailed were undertaken to determine the incubation period of the eggs. It was hoped by this means to fix some definite period, during which dressings are necessary to prevent these apparent reinfestations which, as subsequently confirmed, may not infrequently be due to the late hatching out of eggs.

PRELIMINARY TRIAL.

In order to ascertain if the nits of *H. asini* could be incubated successfully when removed from the horse, some nits were collected on 20. iv. 1918, at No. 1 Reserve Veterinary Hospital, Woolwich. The nits, 79 of which appeared sound, were placed in a tube and carried away in a vest pocket (at ca. 75°–80° F.). Subsequently they were left in a discarded coat for 24 hours at ca. 55°–60° F., before being placed in a small entomological box suspended from a man's neck in a thin cotton bag between the skin and shirt. The temperature in this situation when indoors ranged between ca. 90° F. by day, and ca. 95° F. at night; when out of doors the temperature fell to a variable extent. On the fourth day, through an oversight, the bag with the nits was left for 10–11 hours at ca. 63° F., but afterwards it remained next the skin except when removed for examination.

The age of the eggs was of course not known. They hatched as follows:

Record relating to 79 eggs incubated on man.

On day	...	...	2	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
There hatched	...	1	3	5	5	2	3	7	4	1	1	2	2	4	–	2	–	1	1		eggs.
Total hatched																					46 (58 %).

EXPERIMENTS WITH DATED EGGS.

(a) *Collection of Eggs.* Attempts were made in various ways to obtain eggs within 24 hours of their being laid. Cages composed of felt rings with gauze tops failed because the horses usually succeeded in moving the pads by twitching their skin, and, when this difficulty was overcome, it was found that the lice persistently forced their way out underneath the felt. Various types of cage were tried with both tops and bottoms of gauze, but these failed, owing to the temperature inside the box being too low for oviposition.

Attempts to feed the female lice on animals other than the horse were likewise unsuccessful¹.

Eventually cages were made by covering the bottom of pill boxes (ca. 1½ inches diameter) with gauze and the top with linen; these boxes were filled loosely with horse-hair and placed under a felt pad (ca. 9 inches × 3 inches × ¾ inch). Three holes, to fit the boxes, were cut in the centre of the felt to a little less than the depth of the box and in the centre of each of these depressions a hole (¼ inch) was cut to ensure ventilation. The pad with its three cages was fastened to the horse's side by a kind of broad surcingle made of open mesh (½ inch) string netting. About 50 ♀♀ and 12 ♂♂ were placed in each box. This device answered our purpose, but many lice failed to feed through the gauze and consequently the number of eggs obtained was limited.

(b) *Incubation at 100° F. (dry).* The first trials were made by simply placing the eggs in an incubator at 100° F. Of ten batches of about a dozen each, not a single egg hatched in a month, none showed signs of development—they had simply dried up.

To prevent this dessication the boxes were placed on a wire tray supported over water so as to keep the atmosphere always saturated with moisture. Under these conditions a batch of ten eggs all hatched on the sixteenth day.

(c) *Incubation at 70°–80° and 100° F. (damp).* The next trial was made at a lower temperature in an old incubator with a fluctuating temperature of from 70° F. at night to 80° F. by day. The eggs were collected every 24 hours and each batch divided into two equal lots, the first lot being placed in the above incubator with a dish of water, and the second incubated simultaneously at 100° F.

The following is the result.

		70°–80° F.	100° F.	
Eggs hatched on day 15 (evening)	...	—	14	} Total hatched 112
" " 16 ...	...	—	91	
" " 17 (morning)	...	—	7	
Eggs failed to hatch (2 months)	...	117	2	} Total failed 119

Of the eggs incubated at 70°–80° F. 94 developed moulds, 12 became discoloured and soft, and 11, which after three months showed no change, were found on being opened to contain a viscid opalescent fluid.

(d) *Incubation at 85°–100° and 100° F.* Two experiments were made, each in a humid atmosphere and with a temperature fluctuating between 85° F. and 100° F. The first was made in the incubator mentioned in the last experiment, 36 eggs in five lots being used, and five lots of two eggs each as controls. The second was made by placing the eggs in a bag and incubating by a similar method to that used in the preliminary experiment, 58 eggs in

¹ Of seven lice kept on the arm of one of the writers, only two bit and succeeded in filling themselves with blood, but they died next day whilst the remainder lived three days longer. Out of some dozens of lice tested at various times, only three have been induced to feed.

six lots being used, again with two eggs as control for each lot. The results in both cases were similar and the table below shows the net result.

				Control	
				85°-100° F.	100° F.
No. of batches				11	11
Eggs hatched on day 16	...			—	17
" "	17	...		3	5
" "	18	...		16	—
" "	19	...		11	—
" "	20	...		8	—
" "	21	...		5	—
" "	22	...		7	—
" "	23	...		—	—
" "	24	...		3	—
" "	25	...		1	—
" "	26	...		7	—
" "	27	...		2	—
" "	28	...		1	—
" "	29	...		3	—
" "	30	...		—	—
" "	31	...		—	—
" "	32	...		2	—
" "	33	...		3	—
" "	34	...		1	—
Failed to hatch (2 months)	...			21	—
Total	...	...	...	94	22

(e) *Incubation on the Horse.* A final test was made with two batches of five and four eggs respectively, actually laid and remaining in a horse's coat. These were obtained in July, 1918, in one of the felt-ring cages mentioned under *Collection of Eggs*.

No. of batches	2
Eggs hatched on day 17	3
" " 18	3
" " 25	1
Eggs lost ...	2
Total number of eggs ...	9

CONCLUSIONS.

1. Our experiments show that the eggs of *H. asini* may take as long as a month or more to hatch. Therefore animals infected with *H. asini* must be kept under observation, and the last dressing given not less than 34 days after the time the treatment started.

It has not been possible to determine the minimum time required for a horse-louse to develop from the egg to the fertile female, but from analogy it will probably be about a fortnight, it having been found that in insects of this class the incubation and maturation periods are approximately equal.

This, if correct, would mean that supposing all active stages are killed at each dressing and the treatment repeated at ten-day intervals, four dressings at least must be given, for, although no more eggs will be laid during the period over which the dressings extend, there is every probability that if this period is curtailed a few of the original stock may hatch after a month and restart the infestation.

2. The normal incubation period would appear to be 16–20 days, and the minimum period, under natural conditions, about 15–16 days.

3. A very small amount of *dry* heat will kill eggs. Even at blood heat it was found that 24 hours in a dry atmosphere prevented hatching.

It is evidently due to the effect of temperature that the lice in hot weather migrate to sheltered parts of the body. The eggs are usually laid close to the skin, and, in a partly clipped horse, the lice migrate to the unclipped portions.

4. Moist cold kills the eggs, whereas dry cold only has the effect of lengthening the incubation period by a few days. How long they can withstand this dry cold has not yet been determined, but a week in a cold *dry* room with a temperature of about 50° F. resulted in killing about 50 per cent. and lengthening the incubation period of the remainder from the normal 16 days at 100° F. to 18 days.

ERRATUM TO VOL. XI.

p. 225, line 12, *read* 0·5 (caustic soda 0·5 pt.) *for* 5