

THE INCIDENCE OF BLACKHEAD AND OCCURRENCE OF  
HETERAKIS PAPILLOSA IN A FLOCK OF ARTI-  
FICIALLY REARED TURKEYS.

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During the season of 1920 a flock of turkeys reared in incubator and brooder, and on new soil, has provided further data on the incidence of blackhead under such circumstances and has furnished additional evidence that this method is a successful means of rearing turkeys. Interesting data have also been obtained on the occurrence of the worm (*Heterakis papillosa*) shown in previous work to be a factor in the production of this disease and some evidence has been obtained on the source of this worm in the environment under which the experiments were conducted.

The ground on which the flock was reared was in a large, well fenced horse paddock which had not been used for turkeys or chickens for a period of more than 3 years. The soil was plowed and sown in the spring. The old turkeys and poultry were confined in enclosures at a distance from the paddock and precautions were taken to prevent attendants carrying infection from these to the flock in the paddock. As in the previous field experiments no attempt was made to exclude wild birds.

Three lots of eggs were incubated in commercial incubators. These yielded 85 poults. The lots were brooded separately and kept apart in coops and enclosures of their own until August 9 when they were combined into one flock and given the run of the paddock, within which the enclosures used up to this time had been located. Lot 1 was hatched May 30, Lot 2 June 9, and Lot 3 June 22. They were placed outdoors June 9 and 15, and July 1 respectively.

Up to October 1, nine had died of miscellaneous causes and four from blackhead. Twenty-eight in all had been removed at intervals

for experimental purposes. The remaining birds were in a flourishing condition. Of those that died of miscellaneous causes, one was trampled to death, in two the cause of death remained undetermined, two died of general weakness, two of leg weakness, one of typhlitis, and one of enteritis. After October 1, one other case of blackhead occurred and one more bird was removed for experimental purposes.

It will be noted that, in all, five cases of blackhead occurred in the flock. The dates on which the birds became sick were July 14, September 3, 15, 17, and October 5. The contents of one cecum in the first case were washed and sedimented for worms and one young *Heterakis papillosa* was found. The second case was not examined for worms. The contents of both ceca of the three remaining cases were washed and sedimented, and ten *Heterakis* small to full grown were found in one, one young and one full grown in another, and two full grown specimens in the third. Three of the birds were examined for coccidia with negative results.

With the exception of four birds retained for breeding, the remainder of the flock consisting of 42 birds was killed for food purposes during November and December. Data on these turkeys are given in Table I. The organs of all were examined for lesions of blackhead and for scars. The examination proved entirely negative. None of these birds had at any time shown symptoms of illness. All were normal at autopsy with one exception, in which the mucosa at the tips of the ceca was congested and pigmented.

The degree of infestation with *Heterakis* was determined by washing and sedimenting the cecal contents. It will be noted from the table that five were free of worms. Eleven turkeys harbored one worm each; eight, two worms; three, three worms; six, four worms; one, seven worms; three, eleven worms; and one, fourteen worms. As evidence of the difficulty the parasite has in establishing itself in a flock on virgin soil, it is of interest to note the number of cases in which either males alone or females alone were present. In twelve birds only males were present and in six only females. Further obstacles are presented to the multiplication of the parasite in that males alone presumably might occur in one cecum and females in the other, and moreover when both sexes occur together, individuals of both in the same stage of development might not be present, a circumstance not favorable to reproduction.

TABLE I.  
Data on Turkeys Killed for Food.

No. of turkey.	Date killed.	Live weight.	Color.* Sex.*	No. of <i>H. papillosa</i> present.
430	Nov. 4	9½	B.	1 grown, 1 almost grown.
431	" 20		" M.	2 " females.
432	" 20	13¼	" "	None.
433	" 20	9½	W.; F.	"
434	" 20	8¼	B.; "	"
435	" 22	13¼	W.; M.	2 adult males.
436	" 22	13	" "	2 " females, 1 male.
437	" 22	12	" "	4 " " 6 nearly to full grown, 1 young male.
438	" 22	8	" F.	1 adult female, 3 young to grown males.
439	" 23	16½	B.; M.	1 young male.
440	" 23	13½	" "	3 grown females, 4 adult males.
441	" 23	14	" "	3 " males, 1 young female.
442	Dec. 18	13	" "	1 male nearly grown.
443	" 18	13½	" "	5 males and 5 females nearly to full grown and a young stage 2-3 mm. long.
444	" 18	8¼	W.; F.	1 grown male.
445	" 18	8¼	B.; "	4 adult males.
446	" 18	9½	" "	1 male and 1 female, adults.
447	" 20	15	W.; M.	1 grown male.
448	" 20	8¼	B.; F.	3 " females and 8 males nearly to full grown.
449	" 20	14¼	" M.	1 adult female.
450	" 20	14	" "	1 grown male.
451	" 20	16¼	W.; "	3 adult females and 1 male nearly grown.
452	" 21	9	B.; F.	2 grown females.
452	" 21	9¼	W.; "	1 " female, 1 adult male.
453	" 21	8	B.; "	14 males and females, nearly to full grown.
454	" 21	9½	" "	2 grown males.
455	" 22	10½	" "	1 nearly grown female.
456	" 22	10½	" "	1 " " male.
457	" 22	8½	" "	3 females nearly to full grown.
428	" 22	8½	" "	3 adult females, 1 male nearly grown.
458	" 22	10½	" "	1 grown female, 2 adult males.
459	" 23	12	W.; M.	1 " male.
460†	" 23	14¼	B.; "	None.
461	" 23	9¼	" F.	4 worms.
462	" 28	14	" M.	1 nearly grown male.
463	" 28	16	" "	2 " " males.
464	" 28	16¼	" "	None.
465	" 28	16½	" "	1 nearly grown female.

\* B. indicates bronze; W., white; M., male; F., female.

† Mucosa of tips of ceca greatly congested and pigmented.

As evidence that the flock of turkeys was not one specially resistant to blackhead it will be of interest to consider the history of a number withdrawn during June and July and exposed to an old flock. The data on the incidence of blackhead and the occurrence of *Heterakis* in these furnish a striking contrast to what was observed in those not exposed.

Of twenty-nine birds removed for experimental purposes, sixteen were penned with the old flock beginning in July. All became

TABLE II.  
*Data on Turkeys Exposed to Old Flock.*

No. of turkey.	Date exposed.	Date sick.	Blackhead.	Cecal contents washed and sedimented.	No. of <i>H. papillosa</i> present.
	1920	1920			
400	July 12	Aug. 2	+	Both ceca.	59 young to grown.
401	" 12	" 16	+	" "	21 "
402	" 12	" 8	+	" "	7 " to grown.
403	" 12	July 26	+	" "	About 25 young.
404	" 12	Aug. 16	*		
405	" 12	July 29	+	Both ceca.	11 young.
406	" 12	Aug. 8	+	" "	30 "
407	" 12	" 2	+	" "	90 "
408	" 19	" 6	+	†	
409	" 19	" 8	+	Both ceca.	100 young.
410	" 19	" 23	+	†	
411	" 19	" 16	*		
412	" 12	July 28	+	Both ceca.	7 young.
413	" 12	Aug. 8	+	" "	7 nearly grown.
414	" 12	" 23	+	" "	40 young to grown.
415	" 12	" 16	+	One cecum.	Many, mostly young.

\* Survived.

† No examination for worms.

sick within 42 days (Table II). Two survived and there is every reason to believe that they underwent an attack of blackhead, since both were sick for about 7 days. The diagnosis of blackhead in the others was confirmed at autopsy. In washing and sedimenting the contents of the ceca the number of *Heterakis* present was determined. In eight birds the number of worms ranged from 21 to 100. In the four remaining ones examined, the number found was 7 to 11. It should be stated that the method used in collecting the worms

would not lead to the detection of very young stages. Ten of the birds were examined at autopsy for coccidia with negative results.

Since the flock of normal turkeys was protected from infestation with *Heterakis papillosa* from other turkeys and chickens, the source of this parasite becomes a question for consideration. We have been fortunate in locating at least one of the sources of this infection in the ring-necked pheasant, present in this locality. In the previous fall a pheasant killed on a neighboring farm harbored specimens of this worm. Pheasants have been observed from time to time on the Institute farm and on a number of occasions they have been seen in close proximity to the laboratory and in the paddock in which this year's flock was reared. In June of this season attendants reported on a number of occasions a pair of pheasants present in this paddock. On November 18, a pheasant that had fallen a victim to hunters was found dead in the paddock and at autopsy specimens of *Heterakis papillosa* were found in the ceca. Considering the resistant character of the ova of this parasite, there seems little question that this bird, although present in small numbers, is capable of maintaining a certain degree of soil infestation with this parasite. Fortunately, this does not appear to be sufficiently concentrated to interfere with the successful rearing of turkeys when the soil has been subjected to ploughing and cultivation incident to planting. It will, however, be a safe practice to discourage the visits of this bird.

*Experiment on the Persistence of the Ova of Heterakis in the Soil.*

An enclosure that had proved infectious to turkeys during the season of 1919<sup>1</sup> remained occupied by recovered cases until January 21, 1920, at which time it became vacant and remained closed until June 28, a period of a little over 5 months. This covered a time of exceptionally severe winter weather with much ice and snow. On the latter date, four healthy turkeys, 29 days old, from the normal flock referred to above were placed in the enclosure. These turkeys contracted blackhead in 11, 21, 23, and 28 days respectively. *Heterakis* was present in all. The contents of both ceca were washed and

<sup>1</sup> Smith, T., and Graybill, H. W., *J. Exp. Med.*, 1920, xxxi, 633, Experiment 12, b.

sedimented in the case of three of the birds. In one, seven worms were collected, and in the remaining two, many were found. Only one cecum of the fourth bird was examined and twenty-seven young *Heterakis* were collected.

Although the enclosure during the time it was unoccupied remained accessible to wild birds on the wing, the conditions for visits of hosts of *Heterakis* were on the whole unfavorable. Circumstantial evidence that the ova in the soil had survived and had not been introduced during the interval is furnished by the fact that the number of worms found per bird corresponded with that of the poults penned with the old flock and not with that of the flock on new ground, which was much more favorably located for the visits of birds.

#### SUMMARY.

In a flock of artificially reared turkeys originally consisting of 85 birds and reduced during the summer and fall by deaths and withdrawals for experimental purposes to 42 birds, five cases of blackhead occurred. These appeared during the months of July, September, and October. In four, *Heterakis* was searched for and found. In 38 birds from this flock killed for food during November and December, five harbored no *Heterakis*, and the rest carried light infestations.

Of sixteen healthy birds withdrawn from the above flock during July and placed with a flock of older birds which had passed through this disease in former seasons, all contracted blackhead and fourteen died of the disease. The infestation with *Heterakis* was, as a rule, high, reaching a hundred specimens in some cases. In general, it appears that a high infestation with *Heterakis* is correlated with a high incidence of blackhead, a relation that had already been inferred in feeding experiments. In both of these groups no other species of worm was found in the ceca, and in instances in which examinations for coccidia were made none was found.

Pheasants have been incriminated as a source of infestation with *Heterakis papillosa* in artificially reared flocks.

In an artificially reared flock 38 birds that had never been ill, when killed in November and December, failed to show lesions of blackhead or evidence in the nature of scars that they had passed through an attack of the disease.

Infectious soil that had remained unoccupied by turkeys and chickens for a period of 5 months beginning in the depth of a severe winter still harbored viable ova of *Heterakis* and proved highly dangerous to young poults.

These experiments and observations fail to throw any light on the source of the protozoan parasite (*Amæba meleagridis*) which causes the fatal lesions of blackhead.