

total number of infertile eggs and of the mean of the total number of fertile eggs was almost twice the probable error.

These changes were greater with the increase in egg weight (Table I). The egg shape, defined as the ratio of diameter to length, produced similar effects. The influence of egg weight was also modified by changes of proportional amounts of contents. Relative to the effect of different separations between the upper part of the coil and the egg it was found that the meter readings and frequency dial settings vary only slightly if the variations in weight and shape factor ( $d/1$ ) of the egg are taken into consideration. The correction was made by multiplying each reading by a factor which is:

$$\text{Wt. } x(d/1) \div \text{Wt.}_{\text{av}} x(d/1)_{\text{av.}}$$

Table II presents evidence that most of the current reduction is due to the albumen content of the egg. As for the dielectric effect it is seen that both albumen and yolk had almost the same values as had the eggshell filled with distilled water.

*Summary.* The experiment introduces a new method of measuring conductivity and dielectric effects, independent of electrodes in contact with the material, and is especially adaptable for observations of these properties of a whole egg.

The results indicate that conductivity is lower and dielectric constant higher in fertile fresh eggs than in infertile.

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### The Egg-count Index of *Trichocephalus vulpis* Infections in Dogs.\*

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Leuckart<sup>1</sup> first attempted to determine the egg output of the female *Trichocephalus trichiurus*, the whipworm of man. He calculated that the uterus contained 58,000 eggs, and that 4 to 6 times this number were passed each year, making the daily egg output approximately 1000. From the number of eggs passed daily in the feces of a patient, and from the number of worms found to be harbored by

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<sup>1</sup> Leuckart, R., *Die Menschlichen Parasiten*, 1876, 2nd ed., 188 pp.

the patient when brought to autopsy shortly thereafter, Moosbrugger<sup>2</sup> estimated that each female laid 3333 eggs daily. On the other hand, Manalang,<sup>3</sup> working with colonic feces of autopsied persons, arrived at a figure of 310 eggs per gram of formed feces, which, on the basis of an average daily fecal output of 150 g, would amount to a daily egg output of about 46,000. Correa and Mellone,<sup>4</sup> utilizing the same type of material as did Manalang, calculated that each female *T. trichiurus* laid 315 eggs per gram of formed feces. Since the results obtained by Leuckart and Moosbrugger differ widely from those of the later workers, and since the number of intestinal helminth eggs passed in feces is the only accurate index to the worm burden harbored by the host, it is important to know which of the two groups of results is the more accurate. In order to gain some information on this question, a study was made on the egg output of *T. vulpis*, the whipworm of dogs, a species closely related to that of man.

Six whipworm-free dogs, 2 pups and 4 adults, were utilized. The dogs all harbored hookworms when first examined but were freed of this infection prior to their experimental inoculation with embryonated whipworm eggs. As soon as each animal became positive, egg counts were carried out according to the method of Stoll,<sup>5</sup> and the daily egg output was determined by making counts on a composite sample of feces collected for 3 consecutive days. After the egg output showed a constancy over a period of at least 18 days, the animals were sacrificed, the worms removed, separated as to sex, and counted.

The results of the experiment are presented in Table I. The 6 animals were found to harbor a total of 1731 worms—1148 females

TABLE I.  
Egg Output of *Trichocephalus vulpis* as Determined by Ante-mortem Egg Counts, and Post-mortem Worm Counts.

Dog No.	C1	C2	C3	C4	C5	C6	Total
Daily ante-mortem egg output	107,000	368,000	125,000	96,000	1,152,000	487,000	2,335,000
Females found	52	271	26	25	558	216	1,148
Males "	7	171	11	10	287	97	583
Total	59	442	37	35	845	313	1,731
Avg No. of eggs per female	2,058	1,358	4,808	3,840	2,065	2,255	Avg total 2,035
Avg No. of eggs per worm	1,814	833	3,379	2,743	1,363	1,558	Avg total 1,349

<sup>2</sup> Moosbrugger, *Med. Corr. Blatt des Wurttemberg. artz Landesver.*, **61**, 277.

<sup>3</sup> Manalang, C., *Philipp. J. Sci.*, 1928, **35**, 11.

<sup>4</sup> Correa, M., and Mellone, O., *A Fohla Medica*, 1938, April.

<sup>5</sup> Stoll, N., and Hausheer, W., *Am. J. Hyg.*, 1926, **6**, 134.

and 583 males. The total average number of eggs passed daily was found to be 2,335,000. Dividing this figure by the total number of females recovered, it is found that each female *Trichocephalus vulpis* lays a daily average of 2035 eggs. Dividing the total daily egg output by the total number of worms recovered, it is found that each 1350 eggs in the feces represents one worm in the host. The average daily egg output in the different animals varied considerably (*i. e.*, from 833 to 3379). The lighter infections showed a larger daily egg output per worm.

The ratio of male to female whipworms harbored by the dogs was found to be 1:2. However, a compilation of the number of male and female *Trichocephalus trichiurus* found at autopsy by various workers gives a ratio of 1:1.2.

*Conclusions.* While the results of the present study on the egg output of *Trichocephalus vulpis* cannot be directly applied to that of *T. trichiurus*, they may provide some idea of the true output of the latter. If comparison is permitted with the results obtained by previous workers on *T. trichiurus*, it may be concluded that Leuckart's and Moosbrugger's calculations are much closer to the true ones than are those of Manalang and Correa and Mellone.

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### Studies on Embryonation and Hatching of the Eggs of the Dog Whipworm, *Trichocephalus vulpis*.\*

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The embryonation of *Trichocephalus vulpis* eggs was studied after mechanical agitation by centrifugalization, immersion in brine for a short period, and in sodium chloride solutions of different strengths. The extra-corporeal hatching of fully-embryonated *T. vulpis* eggs was also studied.

The eggs were collected from the feces of infected dogs by sieving, alternate sedimentation and decantation, and finally, in all experiments except the first, by brine centrifugal flotation. All embryonation experiments were carried out at temperatures of 33° to 36°C.

In the experiment to determine the effects of centrifugalization and

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