of lacrimation results in increased alkalinity of the conjunctival surfaces. A larger series must be studied to establish normal values of pH prior to the onset of lacrimation for it is possible that, with further experience and speed of manipulation, the initial pH determination will show a smaller range and a more nearly neutral reaction.

10883

Fertility Study of Fresh Eggs by Radio Frequency Conductivity and Dielectric Effect.

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Observations by Romanoff and Grover[1] indicate that as measured by an audio frequency bridge the electrical conductivity of yolk and albumen of fertile eggs decreased while of infertile eggs increased from the beginning of incubation. This suggested the possibility of observations on the whole egg showing differences between fertile and infertile eggs if a radio frequency circuit were used and effects due to eddy current losses observed.

Also work by Romanoff and Sullivan[2] on the refractive index of egg albumen show some differences in fertile from infertile eggs in early stages of incubation. This difference might be observed as an effect due to change in dielectric constant and more easily measured at radio frequency.

Fertilization occurs at least 21 hours before the egg is laid. During this time the development, initiated by fertilization, presumably has stimulated some enzymatic activity and set up chemical changes within the egg.[3] Therefore, there may be some measurable physiochemical difference in fresh fertile and infertile eggs, though this never has been demonstrated.

Apparatus and methods. A radio frequency circuit consisting of a variable condenser, inductance coil and thermoammeter (Fig. 1A), was driven by a link-coupled stable 5-watt generator at frequencies ranging from the 14.0 to 14.4 megacycles.

The method followed was to observe the effect on maximum current and resonant frequency in the radio circuit by introducing an

[1] Romanoff, A. L., and Grover, H. J., *J. Cell. and Comp. Physiol.*, 1936, **7**, 425.

[2] Romanoff, A. L., and Sullivan, R. A., *Ind. and Eng. Chem.*, 1937, **29**, 117.

[3] Needham, J., *Chemical Embryology*, 1931, p. 247.

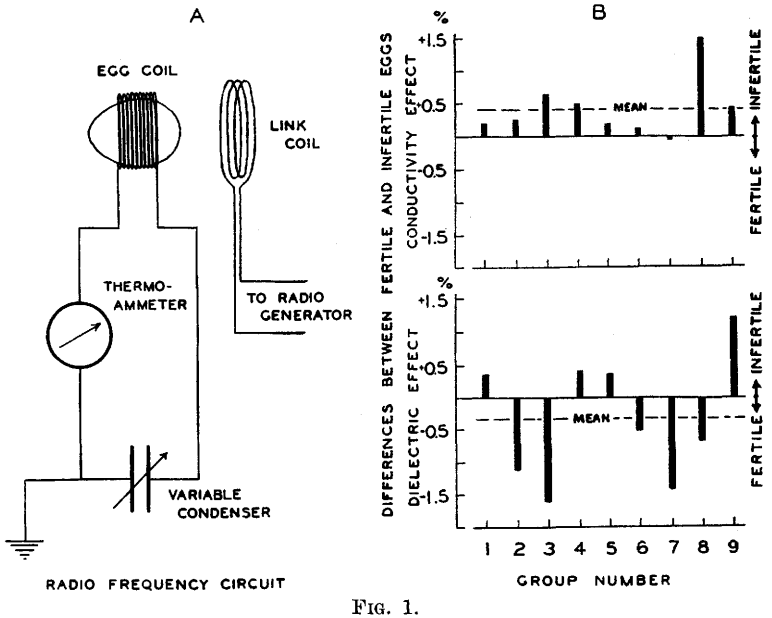

FIG. 1.

A. Circuit diagram: egg coil—length 25 mm, diameter 44 mm, 10 turns, No. 12 copper wire; thermoammeter, 1.5 amp. range; and variable condenser, 30$\mu\mu$f.

B. Comparison of differences in 9 groups of fertile and infertile eggs due to the effects of conductivity and dielectric constant, in a radio frequency circuit.

egg into the coil, unlike previous methods in which the material was placed between the condenser plates.[4] These effects depend upon the conductivity of the egg which reduces the current, and upon its dielectric constant which by increasing the coil capacity lowers the resonant frequency. An attempt was made to correlate these effects with the physical characteristics and morphological structure and with the fertility of the whole fresh egg.

The temperature of the room was maintained at 80°F. The eggs on the day of laying were brought to the room and allowed to come to that temperature over night for observation next day.

Experimental. The observed differences of fertile eggs from infertile are shown in Fig. 1B. For comparison there were used 9 groups in pairs, averaging 12 fertile and 8 infertile eggs per group. The eggs were from a flock of White Leghorn hens, and in groups they were selected for narrow ranges of weight and shape factor.

The results indicate that infertile eggs in 8 out of 9 groups showed greater conductivity than fertile eggs. Dielectric constant was found to be higher for fertile than infertile eggs. This was less evident for individual groups but the difference of the mean of the

[4] Richards, W. T., and Loomis, A. L., *Proc. Nat. Acad. Sci.*, 1929, **15**, 587.

TABLE I.

Relationship Between Energy Absorption and Resonance in Radio Frequency Circuit and Egg Weight, Shape and Proportional Amounts of Contents.

Ammeter reading in amperes	Frequency dial setting in divisions	Width of res. curve at ½ max. in divisions	Egg wt, g	Egg shape diam. / length ×100	Albumen %	Yolk %	Shell %	No. of eggs
1.291-1.335	41.7	22.8	61.0	75.5	63.2	28.3	8.6	6
1.336-1.380	45.3	23.1	60.0	75.2	60.9	29.7	9.4	26
1.381-1.425	49.4	23.8	58.1	74.5	59.4	31.1	9.7	39
1.426-1.470	52.1	24.9	55.8	73.9	59.1	30.9	9.9	51
1.471-1.515	54.6	25.8	54.0	72.1	58.5	31.5	10.0	26

Based on 148 infertile eggs.

TABLE II.

Influence of Replaced Egg-contents on Energy Absorption and Resonance in Radio Frequency Circuit.

Observations	Whole egg	Eggshell empty	Eggshell filled with distilled water	Eggshell filled with albumen	Eggshell filled with yolk
Conductivity:					
Max. ammeter reading with egg*	0.938	1.470	1.462	0.913	1.090
Per cent current reduction	37.5	3.0	3.1	40.0	28.0
Dielectric effect:					
Resonance frequency dial reading with egg†	32.8	75.3	35.2	32.6	32.4
Per cent frequency shift	1.49	0.17	1.42	1.50	1.50

* Maximum ammeter reading without egg 1.515.
† Resonance frequency dial reading without egg 81.0.
The average weight of whole eggs 59.8 g.

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/l) of the egg are taken into consideration. The correction was made by multiplying each reading by a factor which is:

$$\text{Wt.} \times (d/l) \div \text{Wt.}_{av} \times (d/l)_{av}.$$

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.

10884

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

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Leuckart[1] 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

* Aided by a grant from E. Merck and Co.

1 Leuckart, R., *Die Menschlichen Parasiten,* 1876, 2nd ed., 188 pp.