in the chick, Pembrey *et al.*[4, 5] suggested, on the basis of response in gaseous metabolism to changing temperatures, that it occurs just before hatching. However, the observations of Eycleshymer[6] and Penjonschkewitsch and Rotanow[7] indicate that the temperature of the developing egg begins to rise above the temperature of the incubator sometimes during the mid-period of embryonic development.

We have made a further and more detailed study of the temperature changes of the developing chick by the method of cultivation in an opened egg.[8, 9] The plotted data in Fig. 1 in general agree with previous investigations, perhaps with the exception that at later stages of incubation the values are not so low as those of Eycleshymer,[6] observed in water at 36.7° C., and not so high as those of Penjonschkewitsch and Rotanow,[7] observed in a still-air type incubator at 38.5° C. It is not unusual to observe such variation because both hypo- and hyperthermia in precocious birds can be produced experimentally[10] even after hatching when there is a depression or elevation in the environmental temperature.

Our curve demonstrates that the developing chicken egg, although producing heat, at first behaves as a poikilothermic or "cold-blooded" animal. In a few days of incubation the temperature of the egg rises above that of the temperature of the incubator, and the embryo gradually becomes a homeothermic or "warm-blooded" animal. However, the true homeothermy presumably is not acquired by the chick until the fourth or fifth day after hatching[11]

It is also interesting to note that the rise in temperature of the developing egg is not uniform but is somewhat periodic. The periods of decline in the temperature of the egg about the 9th or 10th day and the 15th or 16th day coincide with the observed cyclical suppressions in the growth rate of the embryo.[12]

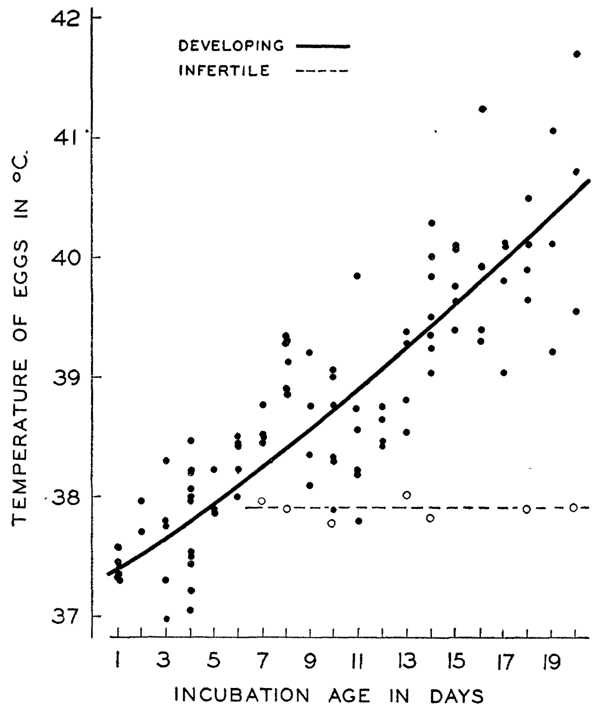

FIG. 1. Temperature changes of the developing eggs. Each dot represents the average value of several measurements on an individual egg. Circles indicate the temperature measurements of infertile eggs. All observations were made in the glass top incubator with slow air movement at the temperature on the level of thermocouple 37.75° C.

ALEXIS L. ROMANOFF

CORNELL UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN A. C. OPERATED ELECTRONIC INDUCTORIUM

ALL the various types of electronic inductoria with which the writer is familiar seem to have been designed to do some specific task and, consequently, little thought seems to have been given to the general applicability or low cost of these designs.[1] There has been a need for an inductorium that would answer the everyday requirements of a physiology laboratory at the low cost and great convenience associated with most electronic devices.

Several inductoria have been constructed here which make use of the familiar saw-tooth wave generator circuit. They have been used for three years in the physiology and the pharmacology departments and have given trouble-free service with a considerable saving in the usual time of experimentation. The circuit

[4] M. S. Pembrey and M. H. Gordon, *Jour. Physiol.*, 16: v–vii, 1894.

[5] M. S. Pembrey, M. H. Gordon and R. Warren, *Jour. Physiol.*, 17: 331–348, 1894–95.

[6] A. C. Eycleshymer, *Biol. Bull.*, 12: 360–374, 1907.

[7] E. E. Penjonschkewitsch and A. N. Rotanow, *Arch. Geflugelkunde*, 8: 369–383, 1934.

[8] A. L. Romanoff, *Anat. Rec.*, 48: 185–189, 1931.

[9] This method permits to maintain a very uniform temperature in the egg free from interferences either of air movement or of changes in atmospheric pressure caused by the presence of egg-shell. The measurements were made by a thermocouple through the window of the egg at temperature of 37.75° C.

[10] J. C. Scholes, Thesis, Cornell University, 1938.

[11] W. F. Lamoreux and F. B. Hutt, *Poultry Sci.*, 18: 70–75, 1939.

[12] A. L. Romanoff, SCIENCE, 70: 484, 1929.

[1] F. A. Fender, SCIENCE, 89: 491, 1939; O. A. Schmitt and O. F. Schmitt, *ibid.*, 76: 328, 1932; O. A. M. Wyss, *ibid.*, 84: 431, 1937.

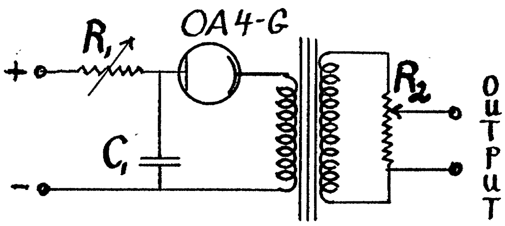

FIG. 1

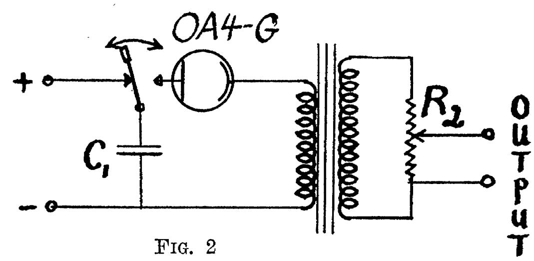

FIG. 2

diagrammed here provides frequency of stimulating impulses adjustable between the range of 2 to 60 impulses per second. Voltage and frequency are independently controlled by dials, single stimuli are obtained by operation of a push-button and a signal magnet is operated simultaneously with stimuli.

Fig. 1 is the schematic diagram of the stimulating voltage circuit. Variable resistor R_1 controls the frequency of the discharge of condenser C_1 through the primary of the transformer T_2. Stimulating voltage

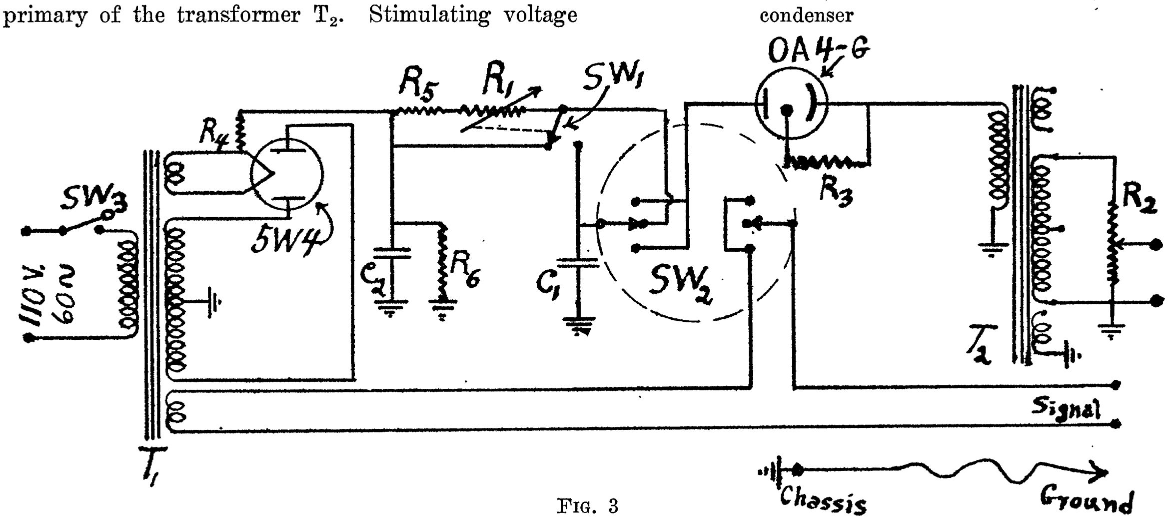

FIG. 3

is controlled by adjusting R_2. It is apparent that there is no interaction of controls R_1 and R_2. In Fig. 2 the schematic diagram for obtaining single stimuli is shown, and Fig. 3 is the actual circuit diagram of the entire apparatus.

In Fig. 3, switch SW_2 is a CRL type 1467, which functions in one position as a push-button, or key, and in the other position as a toggle switch. SW_1, which mounts on the frequency control, R_1, changes the circuit from that of Fig. 1 to that of Fig. 2. A ground wire for the chassis of the instrument is provided to prevent stray contractions caused by stray charges in the instrument.

All components mount in a commercial cabinet, 6″ × 6″ × 6″. The controls and switches are on the top cover of the cabinet, and all other parts mount on a 5″ × 5″ sub-panel, suspended below the top cover.

Values of the parts, available at all large radio supply stores, follow:

T_1, T_2	:	35–40 watt power transformer, 650 v, 6.3, and 5 volt secondaries
Tubes	:	5W4 rectifier; 0A4–G gas-filled tube
R_1	:	2 meg variable resistor
SW_1	:	SPDT switch
R_2	:	20,000 ohm wire wound potentiometer
SW_3	:	SPST switch (mounted on R_2)
R_3	:	30,000 ohm ½ W. R_4 : 5,000 ohm 2W
R_5, R_6	:	100,000 ohm 1 W
C_1	:	0.1 mfd., 1,000 v condenser
C_2	:	8 mfd., 450 working volts electrolytic condenser

A. B. CULLEN, JR.

UNIVERSITY OF MISSISSIPPI

BOOKS RECEIVED

BRINKLEY, STUART R. *Principles of General Chemistry.* Third edition. Pp. x + 703. 179 figures. Macmillan. $4.00.

BUROS, OSCAR K., Editor. *The Second Yearbook of Research and Statistical Methodology.* Pp. xx + 383. Gryphon Press, Highland Park, N. J. $5.00.

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