low-ranking mice have larger adrenals at the end of 10 days under these experimental conditions than do high-ranking mice. The biological significance appears to be that low-ranking mice are subjected to more physical and psychological stressing stimuli. Barnett (1) noted that the function and size of the adrenal cortex was greater in subordinate rats than in dominant rats.

Summary. Mature male "wild-strain mice," isolated from weaning, were placed in groups of 6 for 4 hours a day for 10 days. The social or dominance rank of each mouse was determined. Adrenal and body weights were obtained for each mouse. A significant relationship was found between adrenal weight and social rank. It is concluded that high-ranking mice have smaller adrenals than do low-ranking mice.

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Role of Estrogen in Sex Difference of the Electrocardiogram of the Chicken.* (23068)

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Data from this laboratory show a sex difference in the blood pressure and heart rate of chickens(1) but not in the pigeon and duck(2). It was also shown that estrogen played a role in the blood pressure difference (3). Earlier studies on the electrocardiogram of chickens by Kisch(4) and Sturkie(5) were not concerned with a possible sex difference as their experiments dealt with only one sex, or sex was not indicated.

This report shows that the amplitude of the male chicken ECG is considerably greater than that of the female and that administration of estrogen to the male decreases amplitude significantly.

Procedure. The data pertaining to the normal sex difference in amplitude of ECG are based on records of yearling males and females taken in March and June of 1955. The estrogen experiments were conducted about one year later on yearling males fed a standard commercial diet. ECG's were run on males before, during and 2 months after discontinuance of estrogen treatments. Control ECG's were taken, and one week later the males received one 15-mg pellet of diethylstilbestrol as an implant. Two weeks later another 15-mg pellet was implanted. The second ECG was taken 29 days after the first pellet was implanted. The birds then received a third pellet, and the third ECG was taken 14 days later or 43 days after estrogen was first administered. The last ECG was taken 57 days after the last administration of estrogen. Based upon comb size, the birds appeared to have recovered from estrogen.

ECG's were recorded on unanesthetized birds, using a Sanborn 150-1600-amplifier and a 151-100A recorder, at a chart speed of 50 mm per second. Needle electrodes were inserted in the muscles at the base of right and left wings and the muscle of the left thigh, to form the standard limb leads(5). Amplitudes of 5 or more R and S waves per bird were measured on all ECG's of leads II and III and the averages recorded. P waves of a few selected records were measured, but it is difficult to measure amplitudes of P and T waves because they are often fused in the chicken ECG(6). To measure amplitude accurately at the usual standardization of 1

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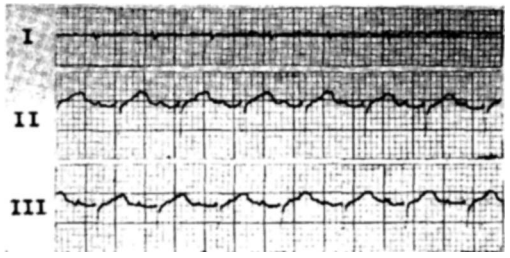

FIG. 1. Leads I, II and III of ECG of normal female chicken. Standardization, 1 cm equal 1 mv, chart speed 50 mm per sec.

cm = 1 mv, the records were magnified so that each unit of measurement equaled ¼ mm or 1/40 mv. RS axes were calculated from leads II and III.

Results. ECG's of normal males and females. The chicken ECG exhibits P, S and T waves and usually a small, abortive R wave but no Q. The R is more prominent in the male but less so than S (Fig. 1 and 2). The amplitude of all waves of lead I is low, and the T wave is usually isoelectric. P and T waves are often fused in the female record, even when recorded on instruments of high frequency (500 cycles per second) and rapid chart speeds (50-75 mm per second). Rarely is this true of the male ECG.

The amplitude of all waves of the male ECG is considerably greater than that of the female. The magnitudes of differences for R, S and RS are shown in Table I, where the amplitude for the male is over twice that of the female. The differences are highly significant statistically.

ECG's of estrogen-treated males. Estrogen

TABLE I. Mean Amplitude in Millimeters of R, S, and RS in ECG, Leads II and III, of Adult Chickens. Standardization, 1 cm = 1 mv.

	II			III		
	R	S	RS	R	S	RS
			25 males			
Mean	2.65	7.95	5.30	1.82	7.72	5.90
S. D.	1.44	2.22	2.93	1.22	2.51	2.43
S. E.	.30	.45	.60	.25	.51	.49
			31 females			
Mean	.83	3.30	2.47	.30	2.80	2.50
S. D.	.81	.85	1.21	.47	.87	.99
S. E.	.15	.16	.22	.09	.16	.18
Mean diff.	1.82	4.65	2.83	1.52	4.92	3.38
t*	5.50	6.00	9.70	9.10	4.40	6.30

* All P values <.01.

TABLE II. Mean Amplitude in Millimeters of RS Complex of ECG of Males (11 to 13) before and after Estrogen Administration. Standardization, 1 cm = 1 mv.

Lead	Before estrogen	During estrogen 29 days	During estrogen 43 days	After estrogen
II	9.	5.70	5.99	7.43
III	10.	6.47	6.43	7.86

administration resulted in a considerable decrease in the amplitude of P, R, and S waves and some decrease in T (Fig. 2). The RS complex is characterized usually by a small R and a prominent S wave. Thus, the changes in R and S resulting from estrogen represent changes mainly in S. The mean amplitudes of RS before, during, and after recovery from estrogen are shown in Table II, and percentage change in Table III. The decrease in RS between treatments 1 and 2, and 1 and 3 (before and during estrogen) in leads II and III range from 33.5 to 36.8%. ECG's run on the untreated birds during these periods exhibited no change. Fifty-seven days after estrogen was administered, or approximately 1 month after all estrogen had been absorbed, (treatment 4), the amplitudes of RS increased from 20 to 30%, but were still less than before estrogen. Although

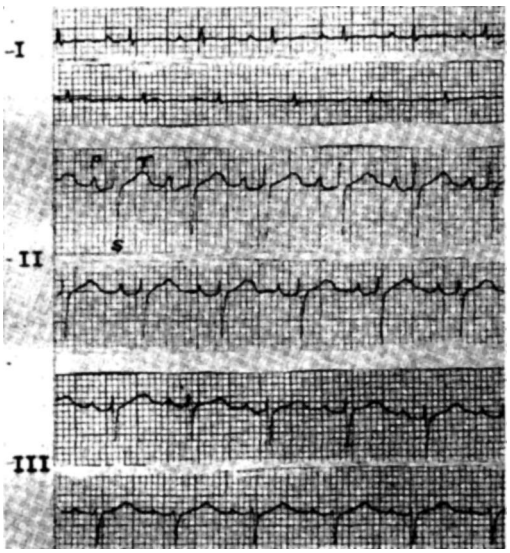

FIG. 2. Leads I, II and III of male chicken before (upper) and after (lower) estrogen administration. Standardization, 1 cm equal 1 mv, chart speed 50 mm per sec.

TABLE III. Percent Difference in Mean RS Complexes of Males before Estrogen (1), during Estrogen (2 and 3) and after Estrogen Administration (4). (Differences paired.)

Treatments, % change from-to	Lead II			Lead III		
	Diff.	Error	t*	Diff.	Error	t*
1 & 2	−36.80	2.04	6.5	−36.05	1.97	7.4
1 & 3	−33.53	2.07	5.4	−36.34	2.17	6.3
1 & 4	−17.64	2.35	3.5	−22.13	2.23	3.7
2 & 4	+30.00	1.83	3.2	+21.68	1.92	3.4
3 & 4	+19.50	1.78	2.2†	+22.25	1.88	2.8

* All t values highly significant except (†) which is borderline.

the ECG's showed a significant recovery from the effects of estrogen it was not complete, because the values were still significantly less than pretreatment values (difference between 1 and 4).

RS axes. The mean electrical axes for the 4 treatments were: 1) 85.8, 2) 82.46, 3) 87.16 and 4) 85.2 degrees. None of the differences is significant.

P wave. The amplitude of the P waves, based on a few selected records, showed a decrease of 21.0% resulting from the estrogen treatment.

Heart Rate was not influenced by estrogen and this confirms our previous findings(3).

Discussion. These data demonstrate that the amplitude of R, S and RS in the normal female chicken ECG is approximately 55% less than that of the male. The voltage of the ECG of the estrogenized male is 30 to 35% less than in normal males. These results might suggest that estrogen plays a role in the normal sex difference of chicken ECG. Laying hens secreting estrogen and estrogenized males exhibit a phenomenal increase in blood lipids and a tendency to obesity(6), which may be conducive to the lower voltage of chicken ECG, as it has been reported to be for the human ECG(7), because adipose tissue tends to shunt or resist cardiac electropotentials(7,8). Whether or not obesity influences voltage of the chicken ECG, and if so, to what extent such changes are influenced by input impedance of amplifier used remains to be determined.

Estrogen at the level administered in this experiment to males depresses size of comb and testes and suppresses the output of pituitary gonadotrophins and androgen. Thus, the decreased amplitude of the estrogenized male ECG could result from lack of androgen rather than the effects of estrogen, and likewise the normal sex difference in ECG may be attributable to androgen rather than estrogen. Further studies on sexually immature males and females and castrates should reveal which gonadal hormones if any, are operative and to what extent.

Summary. The data demonstrate that amplitudes of R, S and RS of the ECG of normal hens are approximately half those of normal males. The effects of estrogen on the ECG of adult males were studied. The voltage of these waves of estrogenized males is decreased about 30 to 35%.

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