

# AN ANALYSIS OF TWO HUNDRED NORMAL ELECTROCARDIOGRAMS

(Subjects Aged 11 to 50 Years)

BY RUSTOM JAL VAKIL, M.D. (LOND.), M.R.C.P. (LOND.), D.T.M. & H.  
(LOND.), F.R.F.P.S.G.

(Hon. Assistant Physician, King Edward Memorial Hospital; some time Hon. Assistant Physician,  
J. J. Hospital; Tutor, Grant Medical College, Bombay; and sometime  
First Assistant, Heart Hospital, Liverpool)

Received June 16, 1941

(Communicated by Lt.-Col. S. L. Bhatia, I.M.S., F.A.Sc.)

THE present study was undertaken with a view to determine normal electrocardiographic standards for Indian subjects. Standards in use in India, at the present day, being unfortunately based on small series of European or American subjects, are inadequate for our needs; they are not in keeping with the growing interest of the clinician in the subject of Electrocardiography. The correct interpretation of an Electrocardiogram demands, first and foremost, a thorough knowledge of the normal state, with all its physiological variations and limits. A search of the literature has failed to reveal a single large-scale investigation carried out in this country into the subject of normal electrocardiographic standards. In two previous issues of these *Proceedings* I have presented detailed studies of normal electrocardiographic records from school-children, aged 5 to 15 years. In the present issue, the study has been extended to a further series of 200 normal subjects, in the 2nd, 3rd, 4th and 5th decades of life. For the sake of uniformity, twenty-five male and twenty-five female subjects have been allotted to each of these four decades, making a total of one hundred male and one hundred female subjects.

An attempt has been made to determine the limits of normal or physiological variation of the various ingredients of the Electrocardiogram, in different age and sex groups.

## *Selection of Material*

Subjects were chosen from diverse sources. Some were medical students, some were friends and relatives who kindly volunteered to their being electrocardiographed, the rest being private and hospital patients with minor surgical and non-cardiac complaints.

Each subject was subjected to a thorough clinical examination in order to exclude the presence of any cardio-vascular disease or any disease capable

of influencing to the electrocardiogram. All cases with symptoms or signs even remotely suggestive of cardiac involvement, e.g., hæmic murmurs, were rigidly excluded from the present investigation.

The tracings were recorded on a Victor (G.E.C.) portable electrocardiograph, with the subject at rest and in a sitting position. Measurements were made in accordance with the standard technique.

### *The P-Wave*

This wave represents early activity of the auricular muscle-fibres; it ends sometime before the actual completion of auricular systole.

*Form of the P Wave.*—The P wave, which is usually described in textbooks as a smooth rounded elevation, actually displays a great variety of forms; it may display rounded, pointed, flat, bifid, inverted and diphasic forms. It has already been demonstrated that the pointed form of P is much commoner than the rounded form in children of school-age. This was found to be the case in the present series of adults also; the percentage frequencies of the pointed and rounded forms of P in this series were 46% and 35% respectively.

The higher incidence of the pointed form of P was observed in all the three standard leads of the Electrocardiogram. The *pointed* form of P was observed in Lead I in 48% of records, in Lead II in 52.5% and in Lead III in 36%. The *rounded* form was observed in Lead I in 39.5%, in Lead II in 36.5% and in Lead III in 29%. Pointed and rounded forms of P were encountered in 6.5% of records in Lead I, in 4.5% in Lead II and in 5.5% in Lead III. *Flat* forms of P were observed in Lead I in 2.5%, in Lead II in 2.0% and in Lead III in 6.5% of records, while the *bifid* form of P occurred in 1.5% records in Lead I, 2.5% in Lead II and 2.0% in Lead III. The *inverted* form of P wave was noted in Lead I in 0.5% records, in Lead II in 1.0% and in Lead III in as many as 12.5% records. The *diphasic* form of P occurred in 1.5% records in Lead I, in 1.0% records in Lead II and in 9.5% records in Lead III.

P waves, intermediate in form between the pointed and the rounded form of P and also, P waves varying in form from the pointed to the rounded or *vice versa*, were classed together in the group known as the “pointed and rounded form” of P wave.

*Notching of P Waves.*—Though formerly recognised as a reliable sign of auricular muscle hypertrophy, P wave notching has now lost its previous significance, having been repeatedly observed by various observers in perfectly normal records.

In my series of normals, notching of the P wave was observed quite frequently. Taking all records into consideration, notching of P was observed in one or more leads in as many as 77 records (*i.e.*, 38.5%); 34 records were from male subjects and 43 from females.

In only 5 cases was notching of P observed in all the three standard leads. Notching of  $P_1$  was noted in 37 records (18.5%), of  $P_2$  in 49 records (24.5%) and of P in 41 records (20.5%). In 40 records (20%), there was notching of  $P_3$  in two leads; notching of  $P_1$  and  $P_2$  in 16 records, of  $P_2$  and  $P_3$  in 16 records and of  $P_1$  and  $P_3$  in 8 records. In 32 records (16%), there was notching of P confined to one lead only; notching of  $P_1$  in 8 records, of  $P_2$  in 12 records and of  $P_3$  in 12 records.

In the 2nd decade group, notching of P was observed in 44% of records (40% of males and 48% of females). In the 3rd decade, notching occurred in 34 % of records (32% of male and 36% of female records). In the 4th decade, notching of P was noted in 34% of records (28% of male and 40% of female records). In the 5th decade, notching was observed in 42% of records (36% of males and 48% of females). It will be noted from the above data, that notching of P is rather more common in normal female than in normal male subjects (ratio of 4:3). The incidence of P wave notching was somewhat higher in the 2nd and 5th decades than in the 3rd and 4th decades, in the present series.

*Notching in P Waves of Large Amplitude.*—It has repeatedly been asserted in medical circles that a combination of notching and large amplitude (over 2 mm.) of the P wave cannot be considered a normal variation and should suggest a diagnosis of mitral stenosis. In the present series of 200 normal records, there were 6 records with P waves notched and more than 2 mm. in amplitude; the amplitudes of P waves in these cases were 2.3 mm., 2.4 mm., 2.1 mm., 2.6 mm., 2.2 mm., and 2.4 mm., respectively; there was no evidence of mitral disease in any of these 6 cases. On the basis of this new series of 200 cases, I can reaffirm my previous statement that in a small percentage of perfectly normal records (3%) there may be an association of notching and large amplitude of the P waves.

*Relation of T to P Waves in Lead III.*—A close relationship or association was observed between the P and the T waves by Hoskin and Jonescu and by Shipley and Hallaran. Inverted P waves meant inverted T waves and diphasic P waves meant diphasic T waves. A study of the present series of normal records supports the first half of this contention. Inverted P waves were observed in Lead III in 12.5% of my records; in every single case, the corresponding T wave was also inverted. Inversion of  $P_3$  was commoner in

females than in males and reached a high incidence in the 5th decade; an incidence rate of 28% in female subjects of the 5th decade.

With regard to diphasic P waves, my findings are not in conformity with those of the above authors. Diphasic P waves in Lead III were observed in 9.5% of my cases, *i.e.*, in 19 records. Of these 19 records, 10 showed inverted T<sub>3</sub> waves, 4 (21%) showed diphasic T<sub>3</sub>, 3 (16%) showed flat T<sub>3</sub> waves and 2 records showed upright T<sub>3</sub> waves. On considering diphasic P<sub>3</sub> waves, the corresponding T deflections were found to display no constant shape or direction.

Flat P<sub>3</sub> waves were noted in 13 records (*i.e.*, 6.5%); of these, 7 records showed flat T waves, 4 showed inverted T waves and 2 showed upright T waves.

*Amplitude or Height of the P Waves.*—The amplitude of P was found to vary from 0.5 mm. to 5.0 mm. with an average value of 1.74 mm. by Hoskin and Jonescu, in their series of fifty normal women. According to Lewis and Gilder, the average values of P for the three standard leads are 0.52 mm., 1.16 mm., and 0.81 mm., respectively.

In my series of 200 normal subjects, the average value of P, taking the three standard leads into consideration, was 1.00 mm. The average value for Lead I was 0.89 mm., for Lead II 1.35 mm., and for Lead III 0.76 mm. High values for P were most often encountered in Lead II, as shown by previous workers, though the maximum value of 3.2 mm. for the whole series was encountered in Lead III.

*Range.*—In Lead I the height of P ranged from – 0.3 to 2.3 mm. in Lead II from – 0.2 to 3.1 mm.; in Lead III from – 2.0 to 3.2 mm. (Please see Table III.)

*2nd Decade.*—The average value of P for male subjects was 0.90 mm. with a range of – 1.1 to 3.0 mm. For females, the average was 0.89 mm., and the range – 1.0 to 3.2 mm.

*3rd Decade.*—The average for males was 0.94 mm., and the range – 2.0 to 3.1 mm.; the average for females was 0.86 mm., and the range – 1.3 to 3.0 mm.

*4th Decade.*—The average value for males was 1.25 mm., and the range – 0.5 to 3.1 mm.; for females, the average was 0.96 and the range – 0.2 to 2.1 mm.

*5th Decade.*—For males, the average value was 1.05 mm., and the range, – 1.2 to 2.3 mm.; for females, the average was 1.05 mm. and the range, – 1.0 to 2.2 mm.

The value of P wave amplitude was somewhat higher in males than in females, in all the standard leads. This is in conformity with the analysis of Shipley and Hallaran.

The average values for P were somewhat higher in the 4th and 5th than in the 2nd and 3rd decades of life.

(For further particulars on P wave amplitude see Table IV.)

*Duration of P Wave.*—In my series, the mean value of P wave duration for the three standard leads was 0·083 sec. The average value for Lead I was 0·080 sec., for Lead II 0·092 sec., and for Lead III 0·077 sec. High values for P wave duration were most frequently encountered in Lead II.

*Range.*—In Lead I, the duration of P ranged from 0·04 to 0·15 sec.; in Lead II, from 0·03 to 0·15 sec.; in Lead III, from 0·03 to 0·14 sec. (See Table V.)

*2nd Decade.*—The average value of P duration for males was 0·080 sec., with a range of 0·04 to 0·15 sec.; for females, the average was 0·080 sec., and the range 0·03 to 0·14 sec.

*3rd Decade.*—For males, the average was 0·085 sec., and the range 0·03 to 0·15 sec.; for females, the average was 0·082 sec., and the range 0·04 to 0·14 sec.

*4th Decade.*—For males, the average was 0·087 sec., and the range 0·04 to 0·14 sec.; for females, the average was 0·083 sec., and the range 0·03 to 0·15 sec.

*5th Decade.*—For males, the average was 0·083 sec., and the range 0·04 to 0·15 sec.; for females, the average was 0·080 sec., and the range 0·04 to 0·14 sec.

P Wave duration appeared to be somewhat higher in males than in females. The average value of P duration shows little or no alteration with age.

#### *P-Q Duration*

This is measured from the end of P to the beginning of the Q wave.

In my series, the average value of P-Q duration, taking all leads into consideration, was 0·056 sec. The average values for the individual leads were as follows: Lead I = 0·052 sec.; Lead II = 0·056 sec.; Lead III = 0·061 sec.

*Range.*—In Lead I, P-Q duration varied from 0·01 to 0·12 sec., in Lead II from 0·00 to 1·12 sec., and in Lead III from 0·01 to 0·13 sec. (See Table VI.)

Maximum values for P-Q duration were observed in Lead I 24 times (12%), in Lead II 44 times (22%) and in Lead III 64 times (32%). A P-Q duration constant in the three leads was noted in 6 records (3%). Maximum values for P-Q were observed in two leads in 22 records (11%), 6 times in Leads I and II, 12 times in Leads II and III and 4 times in Leads I and III.

*2nd Decade.*—The average value of P-Q for males was 0.061 sec., with a range of 0.01 to 0.12 sec.; for females, the average was 0.047 sec., and the range of 0.00 to 0.10 sec.

*3rd Decade.*—The average value for males was 0.059 sec., with a range of 0.02 to 0.12 sec.; for females, the average was 0.050 sec., and the range 0.02 to 0.12 sec.

*4th Decade.*—The average value for males was 0.062 sec., with a range of 0.01 to 0.13 sec.; for females, the average was 0.059 sec., and the range 0.01 to 0.10 sec.

*5th Decade.*—The average value for males was 0.058 sec., with a range of 0.01 to 0.12 sec.; for females, the average was 0.052 sec., and the range 0.01 to 0.12 sec.

The average values for P-Q duration were higher in males than in females, in the present series. Average values were higher in Lead III than in either Lead I or II.

#### *P-R Interval*

This is measured from the beginning of the P wave to the beginning of the QRS Complex. It represents the auriculo-ventricular conduction time.

The average value for P-R duration (in the present series), taking all leads into consideration was 0.148 sec. The average value for Lead I was 0.141 sec., for Lead II 0.149 sec., and for Lead III 0.154 sec.

*Range.*—In Lead I, the P-R interval ranged from 0.08 to 0.21 sec., in Lead II from 0.07 to 0.21 sec., and in Lead III from 0.07 to 0.21 sec. (See Table VII.)

*2nd Decade.*—The average value of P-R for male subjects was 0.143 sec., with a range of 0.07 to 0.21 sec.; for females, the average was 0.123 sec., and the range 0.08 to 0.20 sec.

*3rd Decade.*—For males, the average was 0.147 sec., and the range 0.10 to 0.20 sec.; for females, the average was 0.138 sec., and the range 0.09 to 0.21 sec.

*4th Decade.*—For males, the average was 0.165 sec., and the range 0.11 to 0.21 sec.; for females, the average was 0.155 sec., and the range 0.09 to 0.20 sec.

*5th Decade.*—For males, the average was 0·157 sec., and the range 0·10 to 0·21 sec.; for females, the average was 0·154 sec. and the range 0·09 to 0·21 sec.

The average values for the P-R interval were higher in males than in females and higher in the 4th and 5th than in the 2nd and 3rd decades. P-R values were found to be higher in adults than in children.

*P-R Interval in the Lead of Largest Measurements.*—The two hundred records of my series were investigated from this point of view. Maximum P-R values were observed 72 times (36%) in Lead I, 120 times (60%) in Lead II and 100 times (50%) in Lead III. The P-R interval was identical in the three leads in 16 records (8%). Maximum values for P-R were shared by two leads on 60 occasions (30%), 16 times in Leads I and II, 36 times in Leads II and III and 8 times in Leads I and III.

Values for the maximum P-R duration ranged from 0·09 to 0·21 sec., in the present series, the average value being 0·162 sec. For further details, please refer to Table VIII.

#### *P-R Level or the Auricular T Wave*

The P-R level is seldom iso-electric in all the three leads. There is usually some degree of deflection or deviation from the Zero-line, practically always in a downward direction.

In my series of 200 normal records, a downward deflection of P-R was observed in all three leads in 77 records (38·5%) and in two leads in 76 records (38%); deviation of P-R confined to one lead only was observed in 17 records (8·5%). In 30 records (15%) there was no deflection of the P-R level in any lead. (For details, see Table IX.)

*Measurement of P-R Level Deflection.*—This is measured from the Zero-line, base-line or iso-electric line of the record.

In my series, the average value of the deflection, taking all leads into consideration, was 0·31 mm. The average values for the individual leads were 0·28 mm. for Lead I, 0·36 mm. for Lead II, and 0·30 mm. for Lead III.

*Range.*—In Lead I, the deflection of P-R ranged from 0·5 to 2·0 mm., in Lead II from 0 to 2·2 mm., and in Lead III from 0 to 2·1 mm. (See Table X.)

*2nd Decade.*—The average value of P-R deflection was 0·28 mm. for males, with a range of 0 to 2·0 mm.; for females, the average was 0·27 mm. and the range 0 to 2·1 mm.

*3rd Decade.*—For males, the average was 0.29 mm. and the range 0 to 2.0 mm.; for females, the average was 0.30 mm., and the range 0.0 to 1.8 mm.

*4th Decade.*—For males, the average was 0.34 mm. and the range 0 to 2.0 mm.; for females, the average was 0.33 mm. and the range 0 to 2.0 mm.

*5th Decade.*—For males, the average value was 0.35 mm. and the range 0 to 2.0 mm.; for females, the average was 0.33 mm. and the range 0 to 2.2 mm.

The average values for P-R level deflection were not markedly different in the two sexes, though the values tended to be higher in males in Leads I and II and in females in Lead III. Average values were higher in Lead II than in either Lead I or III.

#### *QRS Complex or Group*

*Duration of QRS Complex.*—It is measured from the beginning of the initial ventricular deflection to the end of the final deflection of QRS.

In my series of 200 normal records from adults, the average value of the QRS duration for all leads was 0.073 sec. The average values for the individual leads were Lead I = 0.073 sec.; Lead II = 0.072 sec.; Lead III = 0.073 sec.

*Range.*—In Lead I, the QRS duration ranged from 0.03 to 0.10 sec., in Lead II from 0.03 to 0.11 sec., and in Lead III from 0.03 to 0.11 sec. (See Table XI.)

*2nd Decade.*—The average value for QRS duration was 0.068 sec. for males, with a range of 0.03 to 0.11 sec.; for females, the average was 0.067 sec., and the range 0.03 to 0.11 sec.

*3rd Decade.*—The average for males was 0.070 sec., with a range of 0.05 to 0.11 sec.; for females, the average was 0.068 sec., and the range 0.04 to 0.10 sec.

*4th Decade.*—For males, the average was 0.076 sec. and the range 0.04 to 0.11 sec.; for females, the average was 0.077 sec., and the range 0.06 to 0.10 sec.

*5th Decade.*—For males, the average was 0.079 sec., and the range 0.04 to 0.11 sec.; for females, the average was 0.075 sec., and the range 0.05 to 0.10 sec.

The average values for QRS were higher in adults than in children (0.073 sec. as compared to 0.067 sec. for children of school-age) and



higher in males than in females (for males 0.073 sec.; for females, 0.072 sec.). The duration of QRS was practically constant in the three leads. The shorter duration of QRS in children is probably due to a shorter conduction system and a smaller ventricular mass.

*Duration of QRS in the Lead of Largest Measurement.*—The two hundred records of my series were investigated from this point of view. Maximum values of QRS duration were observed 84 times (42%) in Lead I, 96 times (48%) in Lead II and 80 times (40%) in Lead III. In 15 records (7.5%), the QRS duration was constant in all the three leads. Maximum values for QRS duration were shared by two leads on 29 occasions (14.5%), 12 times in Leads I and II, 9 times in Leads II and III and 8 times in Leads I and III. Values for maximum QRS duration ranged from 0.05 sec. to 0.11 sec., in the 200 records, with an average value of 0.080 sec. (See Table XII for further details.)

#### *The Q Wave or Deflection*

*Incidence of the Q Wave.*—In my series of records (all cases included) a Q wave was observed in Lead I in 51% of cases, in Lead II in 58% and in Lead III in 66%. In other words, in a series of 200 records, the Q wave was absent in Lead I on 98 occasions, in Lead II on 84 occasions and in Lead III on 68 occasions. A Q wave was observed in all the three leads in 44 records (22%). In 76 records (38%) a Q deflection was noted in two leads, 17 times in Leads I and II, 42 times in Leads II and III and 17 times in Leads I and III.

*In males,* a Q deflection was observed in Lead I in 53% of records, in Lead II in 58% and in Lead III in 70%.

*In females,* A Q wave was present in Lead I in 49%, in Lead II in 58% and in Lead III in 62% of records. (See Table XIII.)

*Amplitude of Q Wave.*—In my series, the average value of the Q wave amplitude, taking all leads into consideration, was 0.48 mm. The average value for Lead I was 0.35 mm., for Lead II 0.47 mm., and for Lead III 0.63 mm.

High values for Q were encountered most frequently in Lead III.

*Range.*—In Lead I, the amplitude of Q ranged from 0 to 4.1 mm.; in Lead II from 0 to 3.0 mm. and in Lead III from 0 to 6.0. (See Table XIV.)

*2nd Decade.*—For males, the average value of Q was 0.57 mm. and the range 0 to 6.0 mm.; in females, the average was 0.56 mm. and the range 0 to 3.8 mm.

*3rd Decade.*—In males, the average was 0.56 mm. and the range 0 to 3.0 mm.; in females, the average was 0.54 mm. and the range 0 to 2.7 mm.

*4th Decade.*—In males the average was 0.42 mm. and the range 0 to 4.2 mm.; for females, the average was 0.48 mm. and the range 0 to 3.0 mm.

*5th Decade.*—For males, the average was 0.31 mm. and the range 0 to 3.4 mm.; for females, the average was 0.39 mm. and the range 0 to 5.0 mm.

The size of the Q wave was, on an average, slightly greater in females than in males. There was no increase in size with age. In the series of cases reported by Chamberlain and Hay, the Q wave was larger in the 5th, 6th and 7th decades than in the 2nd, 3rd and 4th. In my series, the value of Q in the 5th decade was actually lower than in the earlier decades of life.

The value of  $Q_3$  was under 4.2 mm. in all records except two (one male with 6.0 mm. and one female with 5.0 mm.). In Chamberlain's and Hay's series the value of  $Q_3$  was never above 4.5 mm.

#### *The R Deflection or Wave*

*Amplitude of R.*—This is measured from the iso-electric line to the summit of the R wave. In my series of 200 records, the average amplitude of R taking all leads into consideration, was 9.2 mm. The average amplitudes of R in the individual leads were as follows: Lead I = 7.4 mm.; Lead II = 12.0 mm.; Lead III = 8.1 mm.

*Range.*—In Lead I, the amplitude of R ranged from 1.6 to 20.2 mm., in Lead II from 2.9 to 23.2 mm. and in Lead III 0.8 to 19.7 mm. (See Table XV.)

*2nd Decade.*—For males, the average was 8.3 mm. and the range 0.8 to 23.2 mm.; for females, the average was 7.2 mm. and the range 1.0 to 16.2 mm.

*3rd Decade.*—For males, the average was 9.2 mm. and the range 1.5 to 22.6 mm.; for females, the average was 9.5 mm. and the range 3.6 to 21.1 mm.

*4th Decade.*—For males, the average was 10.8 mm. and the range 3.0 to 17.6 mm.; for females, the average was 10.6 mm. and the range 3.2 to 18.2 mm.

*5th Decade.*—For males, the average value was 8.7 mm. and the range 2.2 to 22.2 mm.; for females, the average was 8.7 mm. and the range 2.9 to 19.6 mm.

Average values for R wave amplitude were lower in females in Leads I and II and lower in males in Lead III.

(For further particulars, see Table XVI.)

Out of 200 records in my series, there were 28 records (14%) with the R waves in all leads less than 7 mm. in amplitude. The maximum deflection of R in these cases measured from 5.0 to 6.9 mm. There was not a single case with the maximum amplitude of R less than 5 mm.

### *The S Wave or Deflection*

*Incidence of the S Wave.*—An S wave was observed in the great majority of my records. It was present in Lead I in 70% of records, in Lead II in 77% and in Lead III in 71%.

In 13 records (6.5%), there was a complete absence of the S deflection. (See Table XVII.) There was a higher incidence of the S wave in males than in females and in the later decades of life.

*Amplitude or Size of S Wave.*—The average amplitude of S for the whole series, taking all leads into consideration, was 1.97 mm. The average amplitudes of S for the individual leads were: Lead I = 1.63 mm., Lead II = 2.51 mm.; Lead III = 1.77 mm.

*Range.*—In Lead I, the amplitude of S ranged from 0 to 8.6 mm.; in Lead II from 0 to 10.1 mm. and in Lead III from 0 to 8.6 mm. (See Table XVIII.)

*2nd Decade.*—For males, the average was 1.55 mm. and the range 0 to 10.1 mm.; for females, the average was 1.11 mm., and the range 0 to 7.1 mm.

*3rd Decade.*—For males, the average was 2.15 mm., and the range 0 to 9.2 mm.; for females, the average was 2.22 mm., and the range 0 to 9.3 mm.

*4th Decade.*—For males, the average was 2.09 mm., and the range 0 to 7.8 mm.; for females, the average was 2.5 mm., and the range 0 to 8.2 mm.

*5th Decade.*—For males, the average was 2.00 mm., and the range 0 to 5.6 mm.; for females, the average was 2.05 mm., and the range 0 to 7.2 mm.

### *Notching and Slurring of QRS*

*Notching of QRS.*—In my series of 200 records, notching of QRS was observed in Lead I on three occasions only and in Lead II but once. In Lead III notching of QRS was noted 32 times (16%). In the great majority of cases, notched QRS complexes were either “vibratory” of form or of small amplitude; in two cases notching of QRS was observed with amplitudes of 6.2 and 7.5 mm. (See Table XIX.)

*Basal Slurring of QRS.*—By this term is meant a thickening or splaying out of one or both limbs of the R or S wave, close to or continuous with the iso-electric line. It may occur in perfectly normal records.

In my series, “basal slurring” of R was observed in as many as 62 records (31%). In 3 records (1·5%) basal slurring of R was common to all the three standard leads. In 21 records (10·5%), it was observed in two leads, 6 times in Leads I and II, 8 times in Leads II and III and 7 times in Leads I and III. In 38 records (19%), basal slurring was confined to one lead only, 12 times to Lead I, 17 times to Lead II and 9 times to Lead III.

*Apical Slurring.*—By this term is meant a thickening or splaying out of one or more limbs of the R or S wave, not continuous with the base-line.

In the present series, apical slurring of R was observed in as many as 22 records (11%); in all these cases, the slurring was confined to one lead only; it occurred on 4 occasions in Lead I, twice in Lead II and 16 times in Lead III.

*2nd Decade.*—Apical slurring was observed in 12% of cases in males (once in Lead I and twice in Lead III), and 16% of cases in females once in Lead I and three times in Lead III.

*3rd Decade.*—Apical slurring occurred in 8% of male records (twice in Lead III) and 8% of female records (twice in Lead III).

*4th Decade.*—It was noted in 12% of male records (once in Lead I, once in Lead II and once in Lead III); in female records, it occurred in 8% (once in Lead I and once in Lead III).

*5th Decade.*—It was noted in 12% male records (3 times in Lead I) and in 12% of female records (once in Lead II and twice in Lead III).

R waves with apical slurring were of small amplitude in the great majority of cases (from 1·1 to 5·0 mm.); in 3 records, the amplitude of R was more than 5 mm. (*viz.*, 7·2, 6·2 and 5·8 mm., respectively).

Out of 22 records with apical slurring of R, slurring was observed 8 times in the upstroke and 14 times in the downstroke. Apical slurring of the downstroke was almost twice as common as that of the upstroke, in the present series of records.

#### *The S-T Interval*

This important interval is measured from the end of S to the beginning of the T wave.

*Duration of the S-T Interval.*—The measurement of the S-T interval may be extremely difficult or impossible in records, where the T wave appears to arise directly from the preceding QRS complex. Such an apparent absence

of the S-T interval was observed in 25 records of my series (12.5%). The duration of S-T could not be measured in Lead I 7 times, in Lead II 6 times and in Lead III 18 times.

In my series, the average value for the S-T interval, taking all leads into consideration, was 0.088 sec. The average values for the individual leads were as follows: Lead I = 0.087 sec.; Lead II = 0.087 sec.; Lead III = 0.091 sec. High values were most frequently encountered in Lead III.

*Range.*—In Lead I, the S-T interval ranged from 0.02 to 0.16 sec., in Lead II from 0.02 to 0.16 sec., and in Lead III from 0.02 to 0.16 sec. (See Table XX.)

*2nd Decade.*—The average value of S-T for males was 0.085 sec., with a range of 0.02 to 0.16 sec.; for females, the average was 0.089 sec., and the range 0.02 to 0.16 sec.

*3rd Decade.*—For males, the average was 0.089 sec., and the range 0.04 to 0.16 sec.; for females, the average was 0.090 sec., and the range 0.04 to 0.16 sec.

*4th Decade.*—For males, the average was 0.085 sec. and the range 0.03 to 0.16 sec.; for females, the average was 0.088 sec., and the range 0.04 to 0.16 sec.

*5th Decade.*—For males, the average was 0.088 sec., and the range 0.04 to 0.16 sec.; for females, the average was 0.089 sec., and the range 0.02 to 0.16 sec.

In 4 records (2%), the S-T interval was identical in all leads (values being 0.04, 0.08, 0.09 and 0.09 sec. respectively.) In 32 records, maximum values for S-T were observed in Lead I; of these, 30 showed similar values for S-T in Lead II and 4 in Lead III. In 46% of records, maximum values were noted in Lead II; of these 30 showed similar values in Lead I and 28 in Lead III. In 58% of records, maximum values for S-T were noted in Lead III; of these, 26 showed similar values in Lead II and 4 in Lead I.

#### *Relation of S-T Segment to the Base-line*

Deviation of the S-T segment from the base-line (or P-R level) was measured in each of the two hundred records of my series. In Lead I, the S-T segment was at the level of P-R in 46%, raised in 18% and depressed in 36% of records. Depression of S-T was more frequently observed than elevation of S-T (ratio of 2:1).

In Lead II, the S-T segment was at the level of P-R in 34%, raised in 20% and depressed in 46%. Depression of S-T was much more common than elevation (ratio of 2.3:1.0).

In Lead III, the S-T segment was at the level of P-R in 44%, raised in 30% and depressed in 26% of records. The above findings are diametrically opposed to those of Hoskin and Jonescu, who found elevation of S-T more common than depression of S-T in Leads I and II and depression of S-T commoner than elevation in Lead III.

*Degree of S-T Deviation.*—S-T deviation seldom exceeds 1 mm. In the present series of records, upward deviation of S-T ranged from 0.1 to 1.2 mm. The maximum figure of 1.2 mm. was attained only once in Lead I. Upward deviation of over 1 mm. was encountered 10 times (5%). No age or sex differences were apparent.

Depression of S-T segment ranged from 0.1 to 1.6 mm. in the 200 records. The maximum value of 1.6 mm. was attained 4 times, 3 times in Lead II and once in Lead III. Values over 1 mm. were noted 12 times (6%).

Elevation of S-T in all three leads was observed in only 3 records (1.5%), while depression in all leads was noted 10 times (5%). In 18 records (9%), there was elevation of S-T in one lead, depression of S-T in one lead and an iso-electric S-T in the remaining lead. In 23 records (11.5%), S-T was raised in two leads and depressed in the third lead. In 28 records (14%), S-T was depressed in two leads and raised in the remaining lead. In 8 records (4%), S-T was raised in two leads and iso-electric in one lead. In 30 records (15%), S-T was depressed in two leads and iso-electric in one lead. In 54 records (27%), S-T deviation was confined to one lead only; of these, 18 showed elevation and 36 showed depression. In 26 records (13%), S-T was iso-electric in all leads.

#### *The S-T Duration*

This is measured from the end of S to the end of the T wave.

The average value for S-T duration, in the present series, was 0.26 sec., taking all leads into consideration. The average value for Lead I was 0.26 sec., for Lead II 0.26 sec., and for Lead III 0.27 sec.

*Range.*—In Lead I, the S-T duration ranged from 0.16 sec. to 0.36 sec., in Lead II from 0.15 to 0.36 sec., and in Lead III from 0.156 to 0.36 sec. (See Table XXI.)

*2nd Decade.*—The average value of the S-T duration for males was 0.25 sec., with a range of 0.15 to 0.36 sec.; for females, the average was 0.25 sec. and the range 0.18 to 0.36 sec.

*3rd Decade.*—For males, the average was 0.26 sec., and the range 0.17 to 0.36 sec.; for females, the average was 0.26 sec., and the range 0.16 to 0.36 sec.

*4th Decade.*—For males, the average was 0·27 sec., and the range 0·20 to 0·36 sec.; for females, the average was 0·26 sec., and the range 0·19 to 0·36 sec.

*5th Decade.*—For males, the average was 0·28 sec., and the range 0·22 to 0·34 sec.; for females, the average was 0·27 sec., and the range 0·20 to 0·36 sec.

In the series of normals reported by Chamberlain and Hay, the value of S-T duration was fairly constant (about 0·28 sec.) and showed no alteration with age. In the present series, there was a slight increase in the duration of S-T with age (a difference of about 0·03 sec., in S-T duration between the values of the 2nd and 5th decades). While the average value for S-T was 0·28 in the series reported by Chamberlain and Hay, it was 0·26 sec. in the present series.

In the series of normals reported by Hoskin and Jonescu the average value of S-T was maximum in Lead I and minimum in Lead III. In my series, the maximum average value of S-T duration was observed in Lead III.

#### *The T Wave or the Second Ventricular Deflection*

*Direction of the T Wave.*—In my series of 200 normal records, the T wave was invariably upright in Lead I with but one exception, where the T wave was iso-electric or flat. In Lead II, the T wave was upright in all but five cases; in two of these, it was iso-electric, in two biphasic and in one inverted. Hence it is justifiable to assume that in Leads I and II, the T wave is practically invariably positive or upright. The reverse holds true in case of Lead III, where there is no constancy at all about the duration or form of the T wave. For an analysis of the T wave duration in Lead III see Table XXII.

*“Pointed” and “Rounded” Forms of T Wave.*—Two main forms of T wave can be distinguished on the basis of contour, viz., the “pointed form” and the “rounded form” of T.

In my series of 200 records, the T wave used in Lead I was “pointed” in 70%, “rounded” in 24% and of the “mixed form” or “pointed and rounded” in 6%. In Lead II T was “pointed” in 49%, “rounded” in 50% and “flat” in 1%. In Lead III, it was “pointed” in 37%, “rounded” in 46%, “flat” in 7·5% and “biphasic” in 9·5%.

Ratio of “pointed” to “rounded” forms in the three leads was as follows : Lead I = 3 : 1; Lead II = 1 : 1; Lead III = 4 : 5.

*Amplitude of the T Wave.*—The average value of T for my series, taking all leads into consideration, was 2·09 mm. The average value of T for Lead I was 2·8 mm., for Lead II 3·5 mm., and for Lead III—0·04 mm.

*Range.*—The amplitude of T wave ranged from 0 to 9·1 mm. in Lead I, from - 0·4 to 10·1 mm. in Lead II, and from - 4·2 to 6·2 mm. in Lead III. (See Table XXIII.)

*2nd Decade.*—For males, the average value of T was 2·31 mm. and the range - 4·2 mm. (observed once in Lead III) to 9·8 mm. For females, the average was 2·10 mm. and the range from - 2·6 mm. (in Lead III) to 7·3 mm.

*3rd Decade.*—For males, the average was 2·4 mm. the range - 2·2 mm. (in Lead III) to 8·1 mm.; for females, the average was 2·3 mm. and the range - 3·1 mm. (in Lead III) to 10·1 mm.

*4th Decade.*—For males, the average was 1·7 mm. and the range - 3·2 mm. (in Lead III) to 7·2 mm.; for females, the average was 1·5 mm. and the range - 4·1 mm. (in Lead III) to 6·1 mm.

*5th Decade.*—For males, the average was 1·8 mm. and the range - 4·0 mm. (in Lead III) to 7·1 mm.; for females the average was 2·2 mm. and the range - 2·6 mm. (in Lead III) to 10·1 mm.

The average values for T wave amplitude were higher in the 2nd and 3rd than in the fourth and 5th decades of life. Average values for male and female subjects were practically identical. Maximum values for T wave amplitude were observed in Lead II and minimum values in Lead III.

(For further particulars, see Table XXIV.)

*Amplitude of T in the Lead of Largest Measurement.*—In this series, the size of T in the lead of largest measurement varied from a minimum of 1·7 mm. to a maximum of 10·1 mm. The maximum figure of 10·1 mm. was observed in Lead II on two occasions only. In Chamberlain's and Hay's series, the maximum figure obtained in Lead II was 12·5 mm.

Values under 2·0 mm. were observed in 6 records only (3%), the figures being 1·8, 1·7, 1·8, 1·9, 1·8 and 1·8 mm. respectively. Values over 5·0 mm. were noted in as many as 21% of the cases. Maximum values for T were noted in Lead I in 43% of records, in Lead II in 56·5% and in Lead III in only 0·5%. Maximum values for T are practically never encountered in Lead III.

The average size of T in the lead of largest excursion, in the present series, was 3·6 mm.

*Duration of T Wave.*—The average duration of T for my series, taking all leads into consideration, was 0·17 sec. Average values for the individual leads were: Lead I = 0·172 sec.; Lead II = 0·173 sec.; Lead III = 0·163 sec.



*Range.*—In Lead I, the duration of T ranged from 0·10 to 0·26 sec.; in Lead II from 0·10 to 0·28 sec.; in Lead III from 0·10 to 0·26 sec. (See Table XXV.)

*2nd Decade.*—For males, the average duration of T was 0·173 sec., with a range of 0·10 to 0·26 sec.; for females, the average was 0·177 sec. and the range 0·10 to 0·28 sec.

*3rd Decade.*—For males, the average was 0·173 sec., and the range 0·12 to 0·26 sec.; for females, the average was 0·166 sec., and the range 0·12 to 0·22 sec.

*4th Decade.*—For males, the average was 0·159 sec., and the range 0·10 to 0·24 sec.; for females, the average was 0·167 sec., and the range 0·12 to 0·24 sec.

*5th Decade.*—For males, the average was 0·167 sec., and the range 0·10 to 0·26 sec.; for females, the average was 0·171 sec., and the range 0·14 to 0·24 sec.

### *The U Wave*

This is also known as “the sixth wave of the electrocardiogram”. It was first noted in 1906 by Einthoven. Its cause is not clear. It is observed in the majority of normal records. Lewis and Gilder noted the presence in about 90% of normal records from adults.

*Incidence of U Wave.*—U waves were observed in the majority of my cases. In 17 records (8·5%), U waves were observed in all the three leads. In 49 records (24·5%), U waves were observed in two leads, 22 times in Leads I and II, 20 times in Leads II and III and 7 times in Leads I and III. In 75 records (37·5%), U waves were confined to one lead only, 29 times to Lead I, 27 times to Lead II and 19 times to Lead III.

The highest incidence of U waves was observed in the 4th decade of life and the lowest in the 2nd decade.

The incidence rate of U waves was practically identical in males and females. (See Table XXVI.)

*Form of U Wave.*—Two main forms of U wave were encountered: (1) the “Pointed” form with short duration and (2) the “rounded” form with long duration.

In 73 records (36·5%), U waves were of the “rounded” variety only; in 49 records (24·5%), they were all of the “pointed” variety; in 19 records (9·5%), both pointed and rounded forms were encountered. The ratio of “rounded” to “pointed” of U, in my series, was 2·5 : 1·0.

*Amplitude of the U Waves.*—The average amplitude of U for my series was 0·56 mm. The average value for the “pointed” form of U was 0·81 mm. and for the “rounded” form 0·34 mm.

*Range.*—The amplitude of U ranged from 1·1 to 0·5 mm. in the 200 records. The “pointed” form of U varied in size from 0·2 to 1·5 mm. and the “rounded” form from 0·1 to 1·2 mm. (For further particulars, see Table XXVII.)

*Duration of the U Wave.*—The average duration of U for the whole series was 0·165 sec. The average value for the “pointed” form of U was 0·135 sec., and for the “rounded” form 0·180 sec.

*Range.*—The duration of U ranged from 0·06 to 0·26 in the 200 records. The “pointed” form of U ranged in size from 0·06 to 0·22 sec., and the “rounded” form from 0·08 to 0·26 sec. (For further particulars, see Table XXVIII.)

### *Summary*

1. A study is presented of two hundred normal electrocardiograms of subjects from the second, third, fourth and fifth decades of life. Each decade of life is represented by twenty-five male and twenty-five female subjects.

2. The various deflections and “intervals” of the normal electrocardiogram are measured, described and analysed. Variations due to age and sex are studied.

3. The results of the investigation are briefly presented in tabular form. (See Tables XXIX and XXX.)

It is with very great pleasure that I acknowledge my indebtedness to the Trustees of the late Sir Ratan Tata for a medical research grant, which has made possible the present investigation. I am also grateful to my patients, friends and medical students for their kind co-operation and patience in the collection of the electrocardiographic material for this study.

[For References, please refer to “An Analysis of Normal Electrocardiograms,” *Proc. Ind. Acad. Sci.*, 1940, 12, 267.]

TABLE I  
Showing Distribution of Subjects in the Present Series

Decade of Life	Males	Females	Total
Second	25	25	50
Third	25	25	50
Fourth	25	25	50
Fifth	25	25	50
Series in general	100	100	200

TABLE II  
A Detailed Analysis of the Different Forms of the P Wave (Case Numbers)

Decade	Sex	Lead	Pointed Form	Rounded Form	Pointed and Rounded Form	Flat or iso-electric Form	Bifid Form	Inverted Form	Diphasic Form	Number of Case Records	Total number of Records
2nd	M	I II III	10 14 9	9 9 6	2 1 2	2 0 3	1 1 1	1 0 3	0 0 1	25	50
	F	I II III	14 22 10	7 1 2	2 0 1	0 1 3	1 1 2	0 0 3	1 0 4	25	
3rd	M	I II III	12 15 8	10 9 8	1 1 0	1 0 2	0 0 1	0 0 3	1 0 3	25	50
	F	I II III	12 16 11	10 6 4	2 1 2	0 1 1	0 1 0	0 0 2	1 0 5	25	
4th	M	I II III	12 10 8	11 14 10	1 1 3	1 0 1	0 0 0	0 0 2	0 0 1	25	50
	F	I II III	12 10 9	11 10 10	2 2 1	0 1 2	0 1 0	0 0 2	0 1 1	25	
5th	M	I II III	12 8 9	10 13 11	2 2 1	1 1 1	0 0 0	0 1 1	0 0 2	25	50
	F	I II III	12 10 8	11 11 7	1 1 1	0 0 0	1 1 0	0 1 7	0 1 2	25	
2nd to 5th	M	I II III	46 47 34	40 45 35	6 5 6	5 1 7	1 1 2	1 1 9	1 0 7	100	200
	F	I II III	50 58 38	39 28 23	7 4 5	0 3 6	2 4 2	0 1 14	2 2 12	100	

TABLE III

*An Analysis of the Amplitude of the P Wave (Values in mms.)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.85	1.12	0.72	0.80	1.26	0.62
	Min.	-0.3	0.0	-1.1	0.0	0.0	-1.0
	Max.	2.1	3.0	3.0	1.8	2.2	3.2
3rd	Aver.	0.91	1.51	0.84	0.84	1.22	0.55
	Min.	0.0	-0.2	-2.0	0.0	0.0	-1.3
	Max.	2.0	3.1	2.6	1.6	2.3	3.0
4th	Aver.	0.86	1.92	0.98	0.79	1.10	1.00
	Min.	0.0	0.0	-0.5	0.0	0.0	-0.2
	Max.	2.3	3.1	2.0	1.8	2.0	2.1
5th	Aver.	1.00	1.20	0.96	0.90	1.42	0.82
	Min.	0.0	0.0	-1.2	0.0	-0.2	-1.0
	Max.	2.1	2.3	2.2	1.6	2.2	1.8
For all decades	Aver.	0.95	1.44	0.77	0.83	1.25	0.74
	Min.	-0.3	-0.2	-2.0	0.0	-0.2	-1.3
	Max.	2.3	3.1	3.0	1.8	2.3	3.2

TABLE IV

*Amplitude of the P Wave (Percentage Frequencies)*

Amplitude Range (in mms.)	Lead I	Lead II	Lead III
-2 to -1	0.0	0.0	2.5
-1 to 0	0.5	1.0	10.0
0 to 1	61.0	40.5	53.5
1 to 2	35.5	43.5	28.5
2 to 3	3.0	13.0	4.0
3 to 4	0.0	2.0	1.5

TABLE V

*An Analysis of the P Wave Duration (Values in seconds)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.078	0.092	0.071	0.079	0.090	0.071
	Min.	0.04	0.04	0.04	0.04	0.05	0.03
	Max.	0.15	0.14	0.13	0.14	0.14	0.12
3rd	Aver.	0.083	0.098	0.074	0.080	0.094	0.073
	Min.	0.06	0.05	0.03	0.04	0.06	0.04
	Max.	0.15	0.15	0.14	0.14	0.11	0.10
4th	Aver.	0.079	0.099	0.084	0.078	0.090	0.081
	Min.	0.04	0.04	0.04	0.04	0.03	0.06
	Max.	0.12	0.14	0.14	0.14	0.15	0.12
5th	Aver.	0.080	0.088	0.082	0.078	0.084	0.079
	Min.	0.04	0.04	0.06	0.04	0.06	0.04
	Max.	0.14	0.15	0.14	0.14	0.13	0.14
For all decades	Aver.	0.080	0.094	0.078	0.079	0.090	0.076
	Min.	0.04	0.04	0.03	0.04	0.03	0.03
	Max.	0.15	0.15	0.14	0.14	0.15	0.14

TABLE VI

*An Analysis of the P-Q Duration (Values in seconds)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.053	0.060	0.071	0.043	0.044	0.053
	Min.	0.01	0.02	0.02	0.01	0.00	0.01
	Max.	0.02	0.12	0.12	0.09	0.10	0.10
3rd	Aver.	0.050	0.060	0.068	0.048	0.050	0.051
	Min.	9.02	0.04	0.02	0.02	0.02	0.03
	Max.	0.12	0.12	0.12	0.11	0.12	0.11
4th	Aver.	0.060	0.060	0.066	0.056	0.060	0.060
	Min.	0.04	0.04	0.01	0.03	0.01	0.02
	Max.	0.10	0.12	0.13	0.10	0.10	0.10
5th	Aver.	0.054	0.058	0.062	0.050	0.052	0.054
	Min.	0.02	0.01	0.04	0.01	0.03	0.02
	Max.	0.12	0.11	0.10	0.12	0.12	0.12
For all decades	Aver.	0.054	0.060	0.067	0.049	0.052	0.055
	Min.	0.01	0.01	0.01	0.01	0.00	0.01
	Max.	0.12	0.12	0.13	0.12	0.12	0.12

TABLE VII

*An Analysis of the P-R Interval (Values in seconds)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.138	0.146	0.144	0.120	0.124	0.124
	Min.	0.08	0.07	0.07	0.08	0.08	0.08
	Max.	0.21	0.21	0.21	0.19	0.20	0.17
3rd	Aver.	0.141	0.148	0.152	0.134	0.140	0.140
	Min.	0.11	0.10	0.12	0.10	0.09	0.09
	Max.	0.20	0.20	0.19	0.20	0.21	0.20
4th	Aver.	0.152	0.164	0.180	0.146	0.158	0.160
	Min.	0.12	0.11	0.12	0.11	0.10	0.09
	Max.	0.20	0.21	0.20	0.20	0.20	0.19
5th	Aver.	0.150	0.152	0.168	0.148	0.154	0.160
	Min.	0.12	0.11	0.10	0.10	0.11	0.09
	Max.	0.20	0.19	0.21	0.19	0.20	0.21
For all decades	Aver.	0.145	0.153	0.161	0.137	0.144	0.146
	Min.	0.08	0.07	0.07	0.08	0.08	0.08
	Max.	0.21	0.21	0.21	0.20	0.21	0.21

TABLE VIII

*Maximum P-R Interval Values in 200 Records (Case Numbers)*

Range of Duration (in seconds)	Lead I	Lead II	Lead III
0.08 to 0.10	3	7	5
0.11 to 0.13	8	14	16
0.14 to 0.16	30	47	28
0.17 to 0.19	24	34	32
0.20 to 0.22	7	18	19

TABLE IX

*Incidence Rate of the P-R Deflection (Case Records)*

P-R Deflection	2ND DECADE		3RD DECADE		4TH DECADE		5TH DECADE		FOR ALL DECADES	
	M	F	M	F	M	F	M	F	M	F
1. In all leads ..	6	8	10	8	11	10	12	12	39	38
2. In two leads ..	12	11	10	11	8	9	9	6	39	37
3. In one lead ..	3	3	2	4	2	0	0	3	7	10
4. In no lead ..	4	3	3	2	4	6	4	4	15	15

TABLE X

*An Analysis of the P-R Level (Values in mms.)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.22	0.36	0.26	0.22	0.32	0.28
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	1.4	2.0	1.0	0.1	1.4	2.1
3rd	Aver.	0.24	0.35	0.28	0.26	0.34	0.30
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	1.6	2.0	1.2	1.8	1.8	1.6
4th	Aver.	0.34	0.38	0.30	0.30	0.38	0.32
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	1.8	2.0	1.8	2.0	2.0	1.8
5th	Aver.	0.34	0.38	0.32	0.32	0.32	0.34
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	2.0	2.0	2.0	2.0	2.2	2.0
For all decades	Aver.	0.29	0.37	0.29	0.27	0.34	0.31
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	2.0	2.0	2.0	2.0	2.2	2.0

TABLE XI

*An Analysis of the QRS Duration (Values in seconds)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.066	0.069	0.068	0.066	0.067	0.067
	Min.	0.03	0.04	0.03	0.04	0.03	0.04
	Max.	0.10	0.11	0.11	0.09	0.10	0.11
3rd	Aver.	0.070	0.070	0.069	0.068	0.068	0.068
	Min.	0.06	0.05	0.05	0.04	0.04	0.05
	Max.	0.10	0.11	0.10	0.10	0.09	0.09
4th	Aver.	0.076	0.074	0.078	0.078	0.072	0.080
	Min.	0.04	0.05	0.06	0.06	0.06	0.06
	Max.	0.10	0.11	0.11	0.10	0.10	0.10
5th	Aver.	0.079	0.080	0.078	0.076	0.076	0.074
	Min.	0.04	0.05	0.06	0.05	0.06	0.05
	Max.	0.10	0.11	0.11	0.10	0.10	0.09
For all decades	Aver.	0.073	0.073	0.073	0.072	0.071	0.072
	Min.	0.03	0.04	0.03	0.04	0.03	0.04
	Max.	0.10	0.11	0.11	0.10	0.10	0.11

TABLE XII

*Duration of QRS in the Lead of Largest Measurement (Case Numbers)*

Range of QRS Duration (in seconds)	Lead I	Lead II	Lead III
0.04 to 0.06	22	32	28
0.07 to 0.08	115	80	92
0.09 to 0.10	66	63	76
0.11 to 0.12	0	5	4

TABLE XIII

*Table showing Incidence Rate of the Q Wave in Separate Age and Sex Groups (Percentages)*

Decade	MALES			FEMALES		
	Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
Second	60	64	80	52	64	68
Third	56	60	72	40	48	56
Fourth	40	52	60	48	60	60
Fifth	56	56	68	56	60	64

TABLE XIV

*An Analysis of the Q Wave Amplitude (Values in mms.)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.45	0.39	0.86	0.46	0.38	0.84
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	4.1	2.6	6.0	3.4	2.3	3.8
3rd	Aver.	0.44	0.60	0.64	0.42	0.62	0.58
	Min.	0.00	0.0	0.0	0.0	0.0	0.0
	Max.	3.0	2.6	3.0	2.0	2.4	2.7
4th	Aver.	0.26	0.40	0.60	0.32	0.40	0.72
	Min.	0.0	0.0	0.0	0.0	0.0	0.1
	Max.	3.1	3.0	4.2	2.0	2.2	3.0
5th	Aver.	0.14	0.42	0.36	0.26	0.52	0.40
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	2.2	2.4	3.4	1.8	2.6	5.0
For all decades	Aver.	0.32	0.45	0.62	0.37	0.48	0.64
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	4.1	3.0	6.0	3.4	2.4	5.0



TABLE XV

*An Analysis of the R Wave Amplitude (Values in mms.)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	7.6	11.6	6.2	6.4	9.8	5.3
	Min.	1.6	2.9	0.8	1.8	3.4	1.0
	Max.	20.2	23.2	18.4	13.6	16.2	12.6
3rd	Aver.	8.4	12.1	7.2	7.8	11.5	9.2
	Min.	3.2	5.1	1.5	3.6	5.3	3.6
	Max.	17.8	22.6	19.7	15.2	21.1	18.9
4th	Aver.	7.2	13.8	11.4	6.6	13.2	12.1
	Min.	3.0	6.2	5.0	3.6	4.8	3.2
	Max.	12.2	17.6	16.8	13.0	18.2	15.8
5th	Aver.	8.3	11.8	6.1	6.8	12.1	7.2
	Min.	5.2	4.9	2.2	3.6	3.8	2.9
	Max.	19.6	22.2	10.8	14.2	19.6	13.0
For all decades	Aver.	7.9	12.3	7.7	6.9	11.7	8.5
	Min.	1.6	2.9	0.8	1.8	3.4	1.0
	Max.	20.2	23.2	19.7	15.2	21.1	18.9

TABLE XVI

*An Analysis of the R Wave Amplitude (Percentage)*

Size of R Wave (Range in mm.)	Lead I	Lead II	Lead III
0.0 to 5.0	929.0	11.5	24.0
5.0 to 10.0	3.5	20.5	38.5
10.0 to 15.0	19.0	38.5	23.0
15.0 to 20.0	8.5	18.5	14.5
20.0 to 25.0	4.0	11.0	0.0

TABLE XVII

*Table showing Incidence Rate of the S Wave in Different Age and Sex-Groups (Percentages)*

Decade	MALES			FEMALES			MALES AND FEMALES		
	Lead I	Lead II	Lead III	Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	76	82	64	62	60	48	69	71	56
3rd	70	76	78	68	76	72	69	76	75
4th	76	82	76	70	78	72	73	80	74
5th	70	75	76	68	82	79	69	79	78

TABLE XVIII

*An Analysis of the S Wave Amplitude (Values in mm.)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	1.62	1.84	1.20	1.12	1.30	0.92
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	6.1	10.1	8.6	7.1	3.6	3.5
3rd	Aver.	1.90	2.92	1.62	1.78	2.85	2.02
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	8.6	9.2	8.5	7.8	9.3	6.6
4th	Aver.	2.10	2.96	1.20	1.80	3.10	2.60
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	5.6	7.8	3.4	4.6	8.2	6.2
5th	Aver.	1.20	2.60	2.20	1.32	2.50	2.32
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	4.1	5.6	5.2	6.0	7.2	6.3
For all decades	Aver.	1.74	2.58	1.56	1.51	2.44	1.97
	Min.	0.0	0.0	0.0	0.0	0.0	0.0
	Max.	8.6	10.1	8.6	7.8	9.3	6.6

TABLE XIX

*Table showing Incidence Rate of the QRS Notching in Separate Age and Sex Groups (Case Records)*

Decade	MALES			FEMALES			MALES AND FEMALES		
	Lead I	Lead II	Lead III	Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	0	0	4	0	0	4	0	0	8
3rd	0	0	5	0	0	3	0	0	8
4th	1	0	4	0	0	2	1	0	6
5th	1	0	5	1	1	5	2	1	10

TABLE XX

*An Analysis of the S-T Duration (Interval in seconds)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.082	0.084	0.090	0.085	0.087	0.094
	Min.	0.03	0.04	0.02	0.02	0.02	0.03
	Max.	0.16	0.15	0.16	0.14	0.16	0.16
3rd	Aver.	0.088	0.086	0.092	0.088	0.090	0.092
	Min.	0.06	0.05	0.04	0.06	0.04	0.04
	Max.	0.16	0.14	0.14	0.12	0.12	0.16
4th	Aver.	0.080	0.086	0.090	0.090	0.086	0.088
	Min.	0.04	0.03	0.04	0.06	0.06	0.04
	Max.	0.12	0.14	0.16	0.14	0.14	0.15
5th	Aver.	0.090	0.088	0.086	0.088	0.086	0.092
	Min.	0.04	0.04	0.04	0.06	0.06	0.02
	Max.	0.16	0.14	0.14	0.15	0.14	0.16
For all decades	Aver.	0.085	0.086	0.090	0.088	0.087	0.092
	Min.	0.03	0.03	0.02	0.02	0.02	0.02
	Max.	0.16	0.15	0.16	0.15	0.16	0.16

TABLE XXI

*An Analysis of the S-T Duration (Values in seconds)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.24	0.25	0.25	0.24	0.25	0.25
	Min.	0.16	0.15	0.16	0.18	0.19	0.18
	Max.	0.36	0.36	0.34	0.34	0.34	0.36
3rd	Aver.	0.26	0.25	0.27	0.26	0.26	0.27
	Min.	0.18	0.17	0.18	0.20	0.16	0.19
	Max.	0.32	0.36	0.30	0.36	0.34	0.36
4th	Aver.	0.27	0.26	0.27	0.26	0.25	0.27
	Min.	0.22	0.23	0.20	0.24	0.19	0.20
	Max.	0.34	0.36	0.36	0.36	0.34	0.36
5th	Aver.	0.28	0.28	0.27	0.27	0.28	0.27
	Min.	0.26	0.24	0.22	0.20	0.20	0.20
	Max.	0.34	0.32	0.34	0.34	0.34	0.36
For all decades	Aver.	0.26	0.26	0.27	0.26	0.26	0.27
	Min.	0.16	0.15	0.16	0.18	0.16	0.18
	Max.	0.36	0.36	0.36	0.36	0.34	0.36

TABLE XXII

*An Analysis of the T Wave Duration in Lead III (Percentages)*

Decade	Sex	Upright Form	Inverted Form	Biphasic Form	Iso-electric Form
2nd	M	40	36	16	8
	F	24	56	8	12
3rd	M	44	36	8	12
	F	40	40	12	8
4th	M	52	40	4	4
	F	48	44	4	4
5th	M	52	28	12	8
	F	52	32	12	4
For all decades	M and F	44	39	9.5	7.5

TABLE XXIII

*An Analysis of the T Wave Amplitude (Size in mms.)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	3.3	3.6	0.03	2.7	3.6	0.01
	Min.	0.4	0.6	-4.2	0.0	-0.4	-2.6
	Max.	9.1	9.8	6.0	6.2	7.3	3.3
3rd	Aver.	3.1	4.1	0.0	3.0	3.6	0.2
	Min.	0.9	0.0	-2.2	0.6	0.8	-3.1
	Max.	7.2	8.1	4.2	6.6	10.1	5.2
4th	Aver.	2.3	3.1	-0.2	2.2	2.5	-0.1
	Min.	0.2	0.5	-3.2	1.0	0.0	-4.1
	Max.	6.0	7.2	3.8	4.6	6.1	4.2
5th	Aver.	2.4	3.0	0.1	2.8	4.1	-0.3
	Min.	0.6	0.5	-4.0	0.5	1.0	-2.6
	Max.	5.8	7.1	5.4	7.8	10.1	6.2
For all decades	Aver.	2.8	3.5	-0.02	2.7	3.5	-0.05
	Min.	0.2	0.0	-4.2	0.0	-0.4	-4.1
	Max.	9.1	9.8	6.0	7.8	10.1	6.2

TABLE XXIV

*Amplitude of the T Wave in 200 Cases (Case Numbers) (Values in mms.)*

Size of T Wave (Range in mm.)	Lead I	Lead II	Lead III
—6.0 to —4.0	0	0	4
—4.0 to —2.0	0	0	20
—2.0 to 0.0	0	1	61
0.0 to 2.0	48	43	54
2.0 to 4.0	111	82	34
4.0 to 6.0	20	42	22
6.0 to 8.0	15	20	5
8.0 to 10.0	6	10	0
10.0 to 12.0	0	2	0

TABLE XXV

*An Analysis of the T Wave Duration (Values in seconds)*

Decade	Value	MALES			FEMALES		
		Lead I	Lead II	Lead III	Lead I	Lead II	Lead III
2nd	Aver.	0.176	0.174	0.170	0.178	0.180	0.172
	Min.	0.10	0.10	0.10	0.10	0.12	0.10
	Max.	0.25	0.26	0.24	0.25	0.28	0.26
3rd	Aver.	0.182	0.176	0.160	0.160	0.172	0.166
	Min.	0.16	0.12	0.12	0.12	0.16	0.14
	Max.	0.26	0.24	0.24	0.18	0.22	0.20
4th	Aver.	0.168	0.170	0.140	0.170	0.168	0.164
	Min.	0.10	0.12	0.10	0.12	0.14	0.12
	Max.	0.20	0.24	0.24	0.24	0.22	0.20
5th	Aver.	0.170	0.168	0.168	0.172	0.174	0.168
	Min.	0.14	0.14	0.10	0.14	0.16	0.16
	Max.	0.24	0.26	0.25	0.20	0.22	0.24
For all decades	Aver.	0.174	0.172	0.158	0.170	0.174	0.168
	Min.	0.10	0.10	0.10	0.10	0.12	0.10
	Max.	0.26	0.26	0.26	0.25	0.28	0.26

TABLE XXVI

*Table showing Incidence Rate of the U Wave in Different Age and Sex Groups (Percentages)*

Decade	Males	Females	Both Sexes
Second	56	60	58
Third	76	72	74
Fourth	72	80	76
Fifth	76	72	74
For all decades	70	71	70.5

TABLE XXVII

*An Analysis of the U Wave Amplitude (Size in mms.)*

Decade	Value	MALES			FEMALES		
		Pointed Form	Rounded Form	U Waves in general	Pointed Form	Rounded Form	U Waves in general
2nd	Aver.	0.92	0.28	0.50	0.64	0.30	0.42
	Min.	0.2	0.1	0.1	0.4	0.2	0.2
	Max.	1.4	1.2	1.4	1.2	0.8	1.2
3rd	Aver.	0.80	0.30	0.55	1.1	0.4	0.75
	Min.	0.5	0.2	0.2	1.0	0.2	0.2
	Max.	1.5	1.0	1.5	1.4	0.8	1.4
4th	Aver.	0.7	0.3	0.50	0.7	0.5	0.60
	Min.	0.4	0.1	0.1	0.6	0.4	0.4
	Max.	1.2	0.6	1.2	0.8	0.6	0.8
5th	Aver.	0.9	0.3	0.60	0.7	0.3	0.50
	Min.	0.6	0.1	0.1	0.4	0.2	0.2
	Max.	1.2	0.4	1.2	1.1	0.4	1.1
For all decades	Aver.	0.83	0.30	0.54	0.79	0.38	0.57
	Min.	0.2	0.1	0.1	0.4	0.2	0.2
	Max.	1.5	1.2	1.5	1.4	0.8	1.4

TABLE XXVIII

*An Analysis of the U Wave Duration (Values in seconds)*

Decade	Value	MALES			FEMALES		
		Pointed Form	Rounded Form	U Waves in general	Pointed Form	Rounded Form	U Waves in general
2nd	Aver.	0·10	0·16	0·14	0·12	0·15	0·14
	Min.	0·06	0·08	0·06	0·06	0·08	0·06
	Max.	0·22	0·22	0·24	0·18	0·20	0·22
3rd	Aver.	0·13	0·17	0·16	0·16	0·19	0·18
	Min.	0·10	0·12	0·10	0·12	0·16	0·12
	Max.	0·20	0·24	0·24	0·22	0·24	0·24
4th	Aver.	0·14	0·18	0·16	0·12	0·18	0·16
	Min.	0·10	0·14	0·10	0·08	0·10	0·08
	Max.	0·20	0·24	0·24	0·18	0·22	0·22
5th	Aver.	0·15	0·21	0·19	0·16	0·20	0·18
	Min.	0·10	0·18	0·10	0·08	0·12	0·08
	Max.	0·20	0·26	0·26	0·20	0·24	0·24
For all decades	Aver.	0·13	0·18	0·16	0·14	0·18	0·17
	Min.	0·06	0·08	0·06	0·06	0·08	0·06
	Max.	0·22	0·26	0·26	0·22	0·24	0·24

TABLE

*A Summary of the Main Deflections and*

Deflection	Feature Investigated	Sex	2ND DECADE			3RD DECADE		
			Aver.	Min.	Max.	Aver.	Min.	Max.
P Wave ..	Amplitude	M	0.90	-1.1	3.0	0.94	-2.0	3.1
		F	0.89	-1.0	3.2	0.86	-1.3	3.0
	Duration	M	0.080	0.04	0.15	0.085	0.03	0.15
		F	0.080	0.03	0.14	0.082	0.04	0.14
Q R S complex ..	Duration	M	0.068	0.03	0.11	0.070	0.05	0.11
		F	0.067	0.03	0.11	0.068	0.04	0.10
Q Wave ..	Amplitude	M	0.57	0.0	6.0	0.56	0.0	3.0
		F	0.56	0.0	3.8	0.54	0.0	2.7
R Wave ..	Amplitude	M	8.3	0.8	23.2	9.2	1.5	22.6
		F	7.2	1.0	16.2	9.5	3.6	21.1
S Wave ..	Amplitude	M	1.55	0.0	10.1	2.15	0.0	9.2
		F	1.11	0.0	7.1	2.22	0.0	9.3
T Wave ..	Amplitude	M	2.31	-4.2	9.8	2.4	-2.2	8.1
		F	2.10	-2.6	7.3	2.3	-3.1	10.1
	Duration	M	0.173	0.10	0.26	0.173	0.12	0.26
		F	0.177	0.10	0.28	0.166	0.12	0.22
U Wave ..	Amplitude	M	0.50	.10	1.4	0.55	0.20	1.5
		F	0.42	0.20	1.2	0.75	0.20	1.4
	Duration	M	0.14	0.06	0.24	0.16	0.10	0.24
		F	0.14	0.06	0.22	0.18	0.12	0.24
P-Q Interval ..	Duration	M	0.061	0.01	0.12	0.059	0.02	0.12
		F	0.047	0.00	0.10	0.050	0.02	0.12
P-R Interval ..	Duration	M	0.143	0.07	0.21	0.147	0.10	0.20
		F	0.123	0.08	0.20	0.138	0.09	0.21
P-R Level ..	Deviation	M	0.28	0.0	2.0	0.29	0.0	2.0
		F	0.27	0.0	2.1	0.30	0.0	1.8
S-T Interval ..	Duration	M	0.085	0.02	0.16	0.089	0.04	0.16
		F	0.089	0.02	0.16	0.090	0.04	0.16
S-T Duration ..	Duration	M	0.25	0.15	0.36	0.26	0.17	0.36
		F	0.25	0.18	0.36	0.26	0.16	0.36



XXIX

“Intervals” of the Electrocardiogram

4TH DECADE			5TH DECADE			FOR ALL DECADES			Scale
Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	
1.25	-0.5	3.1	1.05	-1.2	2.3	1.05	-2.0	3.1	mm.
0.96	-0.2	2.1	1.05	-1.0	2.2	0.94	-1.3	3.2	”
0.087	0.04	0.14	0.083	0.04	0.15	0.084	0.03	0.15	sec.
0.083	0.03	0.15	0.080	0.04	0.14	0.082	0.03	0.15	”
0.076	0.04	0.11	0.079	0.04	0.11	0.073	0.03	0.11	sec.
0.077	0.06	0.10	0.075	0.05	0.10	0.072	0.03	0.11	”
0.42	0.0	4.2	0.31	0.0	3.4	0.46	0.0	6.0	mm.
0.48	0.0	3.0	0.39	0.0	5.0	0.50	0.0	5.0	”
10.8	3.0	17.6	8.7	2.2	2.2	9.3	0.8	23.2	mm.
10.6	3.2	18.2	8.7	2.9	19.6	9.0	1.0	21.1	”
2.09	0.0	7.8	2.00	0.0	5.6	1.96	0.0	10.1	mm.
2.50	0.0	8.2	2.05	0.0	7.2	1.97	0.0	9.3	”
1.7	-3.2	7.2	1.8	-5.0	7.1	2.1	-4.2	9.8	mm.
1.5	-4.1	6.1	2.2	-2.6	10.1	2.1	-4.1	10.1	”
0.159	0.10	0.24	0.167	0.10	0.26	0.168	0.10	0.26	sec.
0.167	0.12	0.24	0.171	0.14	0.24	0.171	0.10	0.29	”
0.50	0.10	1.2	0.60	0.10	1.2	0.54	0.1	1.5	mm.
0.60	0.40	0.80	0.50	0.20	1.1	0.57	0.2	1.4	”
0.16	0.10	0.24	0.19	0.10	0.26	0.16	0.06	0.26	sec.
0.16	0.08	0.22	0.18	0.08	0.25	0.17	0.06	0.24	”
0.062	0.01	0.13	0.058	0.01	0.12	6.0	0.01	0.13	sec.
0.059	0.01	0.10	0.052	0.01	0.12	5.2	0.00	0.12	”
0.165	0.11	0.21	0.157	0.10	0.21	0.153	0.07	0.21	sec.
0.155	0.09	0.20	0.154	0.09	0.21	0.142	0.08	0.21	”
0.34	0.0	2.0	0.35	0.0	2.0	0.32	0.0	2.0	mm.
0.33	0.0	2.0	0.33	0.0	2.2	0.31	0.0	2.2	”
0.085	0.03	0.16	0.088	0.04	0.16	0.087	0.02	0.16	sec.
0.088	0.04	0.16	0.089	0.02	0.16	0.089	0.02	0.16	”
0.27	0.20	0.36	0.28	0.22	0.34	0.26	0.15	0.36	sec.
0.26	0.19	0.36	0.27	0.20	0.36	0.26	0.16	0.36	”