

ON
CARDIOVASCULAR AFFECTION IN PULMONARY TUBERCULOSIS.

THESIS.

PRESENTED TO THE UNIVERSITY OF GLASGOW

by

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INTRODUCTION.

INTRODUCTION.

The subject of the functional and pathological changes, to which the cardiovascular system is exposed in pulmonary tuberculosis, has attracted the interest of observers for many years. The very lack, however, of uniformity of findings and conclusions, denotes that herein lies a field worthy of further investigation. Such investigation is, moreover, justifiable in view of its possible importance in relation to modern therapeutics, and in light of the more recent knowledge of the mechanism of the cardiovascular system, and of the technique of its examination.

To the clinician all information regarding the effect of pulmonary tuberculosis on other systems must be of assistance in his estimation of the patient. To the thoracic surgeon, who is daily becoming a more essential link in the therapeutic chain in pulmonary disease generally, a more precise knowledge of the significance of cardiovascular phenomena is of prime importance. The actual relationship between pathological findings in the cardiovascular system, and thoracic surgery, will be outwith the scope of this thesis; but the study has been made, quite apart from its

interest as a purely academic problem, with a desire to crystallise the present knowledge of those factors which do affect the heart in pulmonary tuberculosis.

A complete study must eventually embrace all intrathoracic disease in this relationship, but it has been necessary to limit the field of investigation in the first instance, in order to render the problem and its solution more clear.

The literature on the subject of the heart in pulmonary tuberculosis is not wide. Previous workers have viewed the subject from isolated angles, and, save in the confirmation of the negative findings of others, there has been little uniformity of opinion. The present study has been devoted to sifting the previous literature; an attempt has been made to summarise our present knowledge of the subject, and to insert, where appropriate and pertinent, one's own findings and conclusions. An investigation has been made of a series of cases of pulmonary tuberculosis, in which use has been made of clinical, radiological and electrocardiographic recordings, in order to obtain information as to:-

- (a) whether changes in the lungs affect the pulmonary circulation, and therefore the heart.

3.

- (b) whether toxæmia can produce myocardial degeneration.
- (c) whether other factors may operate, either alone, or in conjunction with the first two, so as adversely to affect the cardiovascular system.

EARLIER VIEWS.

EARLIER VIEWS.

It is comparatively rare for the tuberculous patient to complain of symptoms related to the cardiovascular system, although it has long been recognised that the heart is affected in this disease. The finding of gross abnormality, however, has always been, and still is, a rarity. Laennec mentioned heart disease in his original treatise on phthisis. In 1830 Sir James Clark¹ considered that a small, feeble heart was a strong predisposing factor in the causation of consumption.

By 1885, however, the theory was held by Rokitansky, that lung and heart disease did not occur together. This theory has been proved untenable by the findings of several workers. Lawson-Brown pointed out, that, of 7115 autopsies upon tuberculous subjects, valvular disease of the heart occurred in .9%. Norris performed a series of 8154 autopsies, and found the incidence of valvular disease to be 3.5%. In 1920 Colthorp² made an analysis of 1097 autopsies on tuberculous subjects from the records of the London City Hospital for Diseases of the Chest, between the years 1898 and 1919. He found 29 instances.....2.6%, in which tuberculosis coexisted with valvular disease of the

heart. Norris found that in a series of 449 autopsies upon cases of pulmonary stenosis the incidence of coexisting tuberculosis was 33%. A more recent survey in 1933 by various radiologists, includes an incidence of 3.6% valvular disease discernible radiologically, in 750 cases of pulmonary tuberculosis.³

Tuberculous myocarditis is extremely rare and is almost invariably secondary to tuberculous pericarditis. These conditions will be referred to later.

In spite of the comparative rarity of the coexistence of gross cardiac abnormality and pulmonary tuberculosis, and of the rarity with which patients complain of symptoms attributable to the cardiovascular system, it is possible, nevertheless, to demonstrate that a considerable proportion of tuberculous patients do, in fact, exhibit, on closer investigation, a considerable degree of cardiac abnormality. The study of those factors which contribute to such abnormality, and of the means of assessment of such changes, by methods at present available, constitutes the scope of the present thesis. The material has been drawn from personal experience, and comparison has been made with similar study by other workers.

SYMPTOMATOLOGY OF CARDIOVASCULAR AFFECTION.

SYMPTOMATOLOGY OF CARDIOVASCULAR AFFECTION
IN PULMONARY TUBERCULOSIS.

(A) SYMPTOMS.

1. Palpitation.

It is unusual for the patient suffering from pulmonary tuberculosis to complain of symptoms directly related to the cardiovascular system. Careful enquiry will, however, usually elicit a history of recurrent attacks of palpitation. Such palpitation is doubtless not infrequently the effect of some purely secondary cause. Among such causative factors may be instanced a mild degree of anaemia, which is not uncommonly found in this condition.

Hypotension is a possible cause of palpitation, and will be discussed more fully later. It probably has little to justify the classical importance ascribed to it.

Toxic stimulation of the vago-sympathetic nerve supply to the heart must also be recorded as a possible factor in the production of palpitation, but this hypothesis is difficult to substantiate with the present methods of investigation.

A more interesting hypothesis is based upon the relationship existing between palpitation and cardiac displacement. Theoretically it is justifiable to assume that a heart, displaced from its natural anatomical situation within the thorax, must work at a disadvantage. The physiological channel for the inflow and outflow of blood, must, it would seem, be the seat of greater friction than normal. On mechanical grounds alone, then, one would expect subjective evidence of such an alteration. Actually there is little correlation between radiological evidence of cardiac displacement and palpitation. This statement no longer holds good, however, where the cardiac displacement is the result of thoracoplasty, after which operation, a definite, though not high, proportion of patients do suffer from a considerable degree of palpitation.

With primary tuberculous pericarditis, we are not, for the moment, directly concerned. Tuberculosis of the myocardium is a very rare disease, the auricles being usually the portion affected. The condition is rarely other than secondary to tuberculous pericarditis, but in a few cases it has been believed to be the result of a blood borne infection from some extra-cardiac source such as the lungs, or infection may be transmitted via the mediastinal glands.

The condition is mentioned at this stage because it may give rise to an ectopic rhythm such as fibrillation, or premature contraction, such signs offering irrefutable proof of myocardial infection.

There remains the possibility that the symptom of palpitation results from the effect of a chronic toxæmia upon the cardiac musculature. Toxæmia is frequently spoken of in connection with tuberculosis, but the evidence of myocardial degeneration, in any but moribund patients, is, as a rule, slender. Electrocardiographic records, both in the present series of cases, and in those of other workers, will be shown in a later section, to suggest that severe myocardial degeneration is rare, and that when it exists, it may not infrequently be ascribed to other causes.

(B) SIGNS.

1. Tachycardia.

Increased frequency of the pulse has always been ^{found} in a considerable proportion of cases of pulmonary tuberculosis, and some authorities regard it as being a finding of even greater significance than a small elevation of

temperature. Many patients are found, in fact, to have a pulse rate increased out of all proportion to the fever, and this would appear to suggest that tachycardia is not a simple result of increased metabolism associated with pyrexia, but is probably equally the product of some specific stimulus. In the present series, for example, the function of tachycardia, as a product of temperature alone, has been calculated, so as to establish the coefficient of correlation. In order to eliminate, as far as possible, all extraneous factors, the "modal" form of average has been used. By this method, the coefficient of correlation was found to be $+0.344$, which is not high. (see appendix p. 161).

The more probable stimulus is toxæmia, although such a hypothesis is difficult of proof. Nevertheless there are many valid reasons for supposing it to occur, even in the early stages of the disease. Any morbid process which results in considerable tissue necrosis, must produce some reactions as the result of absorption of metabolites into the blood stream. Of these results, increased frequency of the heart would be among the first to occur. The exact mechanism of production of tachycardia, in such circumstances, remains a matter for conjecture, in which connection the possibility of vago-sympathetic stimulation, already referred to, must be

borne in mind; sympatheticotonic individuals being more susceptible to tachycardia than vagotonic individuals.

Paroxysmal tachycardia occurs occasionally in pulmonary tuberculosis, and has been thought to carry a bad prognosis, but of its occurrence, one has had no experience.

Chronic anoxaemia is compensated for by increased cardiac output and frequency, and if this compensatory mechanism be maintained over long periods, cardiac exhaustion will eventually result. Anoxaemia may not be associated with cyanosis, where anaemia coexists.⁴ and 5.

Among the possible causes of tachycardia in pulmonary tuberculosis must be mentioned, the frequent combination of a small heart, with increased basal metabolic rate. The cause of the smallness of the heart is not known, and in any event it is by no means an invariable finding. Various hypotheses will be referred to. King and Hansen⁶ found that, in a series of 100 cases of pulmonary tuberculosis, the average weight of the heart was less than normal. Hawes¹ has put forward the view that the smallness of the heart is due to weakness of the muscle. Weight is given to such a belief, in the work of Simon and Baum,⁷ who examined 250 cases electrocardiographically. They found the

average height of the "T" waves, to be less than that quoted by Lewis⁸ in 52 normal subjects. (See table II, page 48). This they considered indicative of the existence, in tuberculous subjects, of a weakened cardiac musculature.....a condition long suspected by clinicians, but not found, except upon autopsy.

Undoubtedly interesting as the phenomenon is, the importance of the narrow vertical heart, the "cor-
pendulum", of pulmonary tuberculosis, appears to have been much exaggerated. The cardio-phrenic anatomical relationship, which will be discussed later, is probably the principal factor in the production of the small heart.

11. Hypotension.

Hypotension is a classical sign in pulmonary tuberculosis. A survey of text books will show how this "classical" sign is still included in the symptomatology of this disease, whereas there may be less reason for its inclusion today, than formerly. It will be shown that hypotension occurred in only 20% of the present series of cases. Probably observation of this classical sign was more frequently made in the days before radiography, and, no doubt,

at a time when cases were generally more advanced at the time of diagnosis, than they are today.

We now recognise that hypotension in pulmonary tuberculosis is a combined function of:-

- (a) the age of the patient.
- (b) the duration of the disease.
- (c) the extent of the disease.

Pulmonary tuberculosis is most frequently a disease of early adult life, when a low blood pressure is to be expected. Furthermore, patients, in the active stage of this disease, are often at complete rest in bed. As in all cachectic states, terminal cases often exhibit a marked degree of hypotension.

Consideration of hypotension would be incomplete without reference to the possible contributory relationship of chronic toxæmia upon the heart, and of the small and feeble heart already referred to.

It is interesting to note that the experimental injection of tuberculin, even in small doses, is followed by a fall in blood pressure.

In his monograph upon the Heart and Spleen in Health and Disease, Stephens⁹ attaches prognostic significance to the Basic blood pressure in pulmonary tuberculosis, but it

is doubtful if such a conclusion is based on satisfactory evidence.

The sign has lost much of its earlier importance, and is of relatively infrequent occurrence today.

**RADIOGRAPHY OF THE HEART
IN TUBERCULOSIS.**

RADIOGRAPHY OF THE HEART IN PULMONARY TUBERCULOSIS.

I. Radiographical methods of examination.

The size and outline of the heart shadow can be determined, either by direct fluoroscopy, or by the orthodiagram, or by the teleradiogram.

(1) Direct fluoroscopy.

In the case of simple screening, a more or less direct inspection of the heart can be made. In addition to examination in the antero-posterior position, the patient may also be moved into the oblique and lateral positions. In this way, in addition to such changes as general cardiac enlargement, attention may also be centred on particular chambers or vessels, which may be modified in size, shape, and position.

(2) The Orthodiagram.¹⁰

With the orthodiagram, a small beam of rays is moved around the outline of the heart, the edge of which can thus be delineated with a pencil, on the screen, or on paper. This method may be combined with direct fluoroscopy, and gives excellent views and records of the heart shadow. Unfortunately, however, the method is not without

danger, both to the operator and to the patient, if examination be frequently repeated.

(3) The Teleradiogram.

In teleradiography, the X Ray tube is placed some 2 metres distant from the patient, thereby obviating the distortion inseparable from the use of divergent rays, for, at this distance, the rays may be considered parallel.

(See figure I).

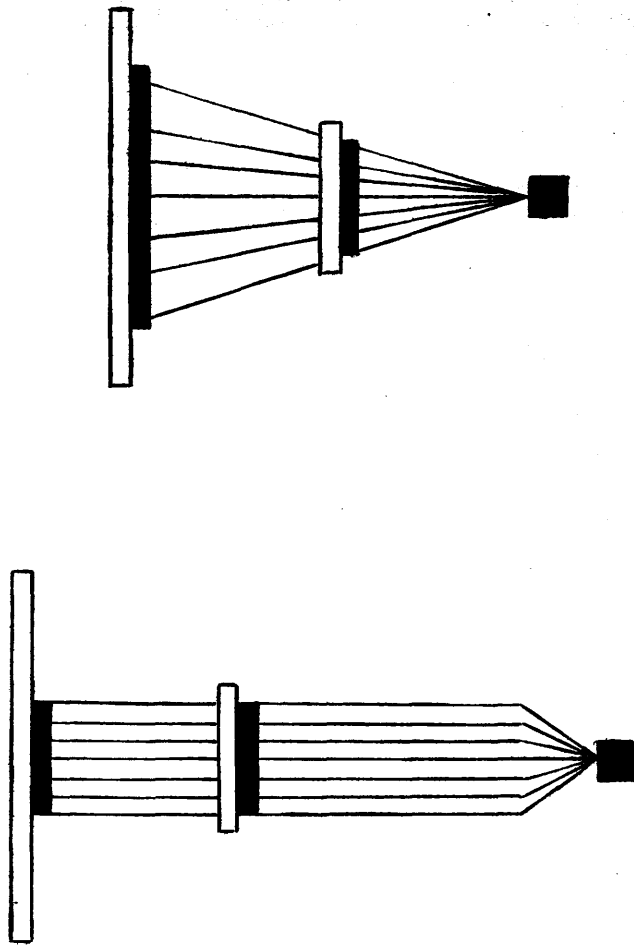


FIGURE 1

The radiogram thus obtained gives a standard record of the size and shape of the heart shadow, suitable for purposes of comparison. This is the method of choice.

(4) The Kymograph.

Mention must be made of Kymography, a method which has recently been devised. Use is made of a fine slit or diaphragm which is fixed over the border of the heart. The X Rays are projected through this slit, and a film is made, in which is recorded a zig-zag, representative of the pulsations of the heart. The interpretation of a kymograph is by no means easy, and the claim of certain workers that this method yields more information than the electrocardiogram, has not, as yet, been substantiated.

Tomography, where rib shadows are eliminated altogether, and where sections of lung tissue may be photographed at different depths, may, in the future, be used in examination of the heart, but the instrument is still in its infancy, and has not yet been used for this purpose.

II. Radiographical appearance of the Heart in Pulmonary Tuberculosis.

Generally speaking, in pulmonary tuberculosis, the cardiac shadow is either small, or of normal dimensions.

Occasionally there is some increase in the size of the right side of the heart, and of the shadow caused by the pulmonary artery. It is quite rare to find a grossly enlarged heart in this disease.

The Small, Dropped Heart.

A certain proportion of cases corresponds to the dropped heart, or "cor-pendulum" to which considerable significance has been attached in the past. The literature on this subject is meagre and vague, and no significant reference has been made in the last fifteen years. It would, for example, be of considerable interest to know the incidence of cardioposis in the normal population.

Historically, the small heart was considered to be a predisposing factor in the causation of consumption, and to some extent this is still believed to be the case. Latham,¹¹ whose study of the subject tends to confirm the older views, concluded that a small heart was often associated with a poor resistance to tuberculosis.

The following are among the possible factors which operate in the production of the small heart:-

- (a) the systemic resistance is generally low, so that less effort is required of the heart. The low peripheral resistance is caused by a state of vasodilatation.
- (b) the nutrition of the heart is faulty.
- (c) tuberculous patients usually undertake the minimum of exertion.

The present day theory.

An interesting hypothesis is now put forward to account for the appearance of the small, dropped heart.¹² The position of the diaphragm is considered to be the greatest factor in deciding the position of the heart. The short, stout individual, with a short wide chest and a high diaphragm, has a heart tilted upwards, and to the left: the tall, thin individual, with a long, narrow chest, and a low diaphragm has a pendulous heart, swung in towards the midline. The heart of the one looks large and horizontalof the other, small and vertical. These observations are interesting in that they recall to mind the description of the phthinoid chest, classically indicative of proclivity to lung disease.

Measurement of the Cardio-Thoracic Index.

The ratio of the transverse diameter of the heart to the internal diameter of the thorax, is known as the cardio-thoracic index. This normally bears the relation of 1 : 2.

The transverse diameter of the heart is the summation of the right and left medial measurements, taken horizontally from the midline to the most distant point of the cardiac shadow, to the right and left, in the standard antero-posterior plane. The average transverse diameter is quoted by Beaumont¹³ as 12.7 centimeters or 5 inches. (See Figure II).

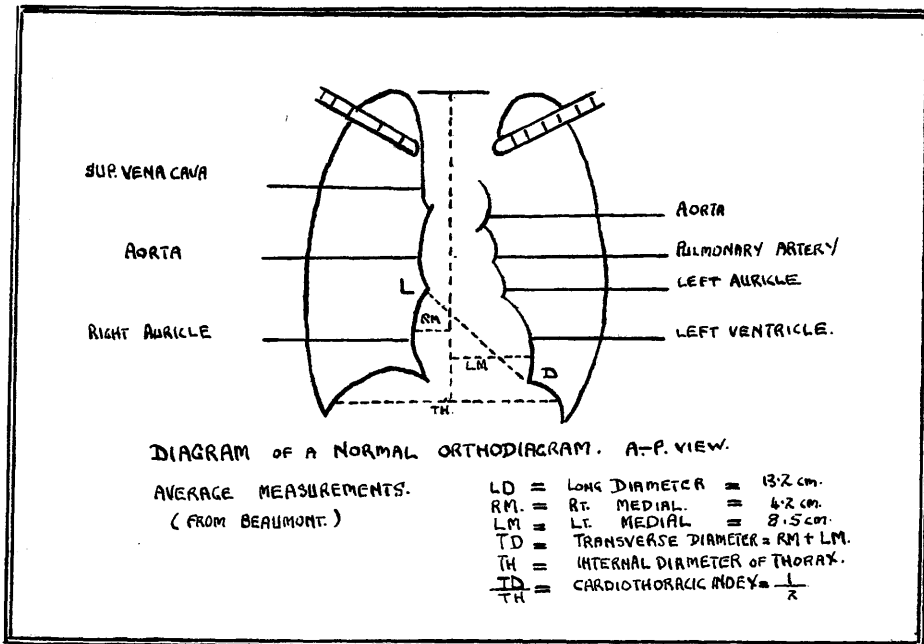


FIGURE II.

In 1930 King and Hansen⁶ in U.S.A. made a survey of 100 cases of pulmonary tuberculosis, using the combined method of radiography, and electrocardiography (see page 50). In the radiological part of their study they made the following arbitrary classification of the cardiac shadows they obtained:-

- (a) ASTHENIC HEARTS.....cardio-thoracic index of under 40%.
- (b) STHENIC HEARTS.....cardio-thoracic index of 40% to 60%.
- (c) HYPERSTHENIC HEARTS..cardio-thoracic index of over 60%.

This method of classification is simple, and allows of comparison between various series of cases and has been adopted throughout the present study.

The incidence of asthenic hearts in a series of control normal cases was 21%. In King and Hansen's series, it was 32%, and in the present series, 31.1%.

Other Radiological Appearances.

There remain the radiological appearances associated with various diseases of the heart. Such findings may occur coincidentally with pulmonary tuberculosis, but usually have no direct relationship with this disease. An exception may be cited in the case of the shadow caused by

a dilated right heart, frequently associated with enlargement of the pulmonary artery, such as may be encountered in advanced pulmonary fibrosis. Similarly shadows typical of congenital heart disease, may be associated with a supervening tuberculous infection of the lungs. Cardiac displacement, due to pleuropericardial adhesions, pulmonary fibrosis or pneumothorax, will display the shadow typical of these conditions.

Before leaving the subject, mention must be made of the peculiar and interesting cardiac shadows met with in industrial diseases associated with the inhalation of dusts containing silicon dioxide and magnesium silicate. In both silicosis and asbestosis, when complicated by pulmonary tuberculosis, there is found in certain cases a peculiar appearance known as the "Shaggy Heart". The shadow has also been likened to the appearance of an inverted brush. Examples of these conditions are included in the present series.

A recent study of the radiological findings of the heart in pulmonary tuberculosis was carried out by Schmidt¹⁴ in 1933, in U.S.A. He collected a series of 750 cases of tuberculosis of varying severity in patients of all ages.

Of the 750, he found 317....42.3%.....to show abnormal radiographic appearances of the heart. Of the abnormal cases, microcardia comprised the majority, while cardiac displacement came next in the list. He found that, among the abnormal, 8.6% were due to organic disease; 3.6% being due to recognisable vavular lesions.

TABLE I.

CARDIAC ABNORMALITY.	AGE INCIDENCE.			TUBERCULOUS CLASSIFICATION.			
	Under 25.	25-45	Over 45	Minimal	Mod. advacd.	Far advacd.	Miliary
1 Small Heart	31	71	44	38	46	62	
2 Cardiac displacement	20	49	24	10	28	55	
3 R.Ventric. Enlargmnt.	5	9	13		8	19	
4 Congenital Heart Dis.	2			1	1		
5 Mitral disease.	1	3	1	3	2		
6 Aortic disease.		4	9	6	4	3	
7 Mitral-Aortic Disease		2	5	4	2	1	
8 Non-Vavular Enlargmnt		3	8	7	3		
9 Aortic Enlargement		2	9	6	5		
0 Aortic Anerysm			2	2			
	59	143	115	77	99	140	

This table contains many points of interest, among which will be seen that, although right ventricular enlargement

increases in direct proportion with age and the state of advancement of the disease, there is to be found a similar trend in the case of the small heart, and in cardiac displacement. Congenital heart disease will be seen to occur among the young, as would be expected, and an advanced tuberculous lesion is not reached.

It is evident, therefore, that radiology alone is not of great assistance in making an exact determination of cardiovascular affection in pulmonary tuberculosis, but when considered along with clinical findings, it may, in a few cases, suggest such affection. Right heart changes, such as enlargement of the shadow of the pulmonary artery, are largely confined to chronic cases, where there is extensive fibrosis which mechanically produces a destruction of a considerable proportion of the pulmonary vascular bed. It is generally agreed that the essential factor, in such cases, is a raised tension in the pulmonary circuit.....a hypertension, as it were, of the lesser circulation, comparable with hypertension of the greater circulation, and its attendant hypertrophy of the left ventricle.

In a series of 120 cases of pulmonary tuberculosis, Hirsch¹⁵ found some degree of Right ventricular enlargement

or hypertrophy in no less than 35%, and it appeared that the degree of hypertrophy was proportional to the extent of pleural and pulmonary fibrosis present. Although this figure is higher than is expected, it does serve to strengthen the view that, in certain cases, at all events, mechanical strain is thrown upon the right side of the heart.

Parkinson¹⁶ has voiced the general conclusion that the heart in pulmonary tuberculosis is only enlarged from other causes, or else that it is a right sided enlargement dependent upon fibrotic or emphysematous change in the lung tissue, involving the pulmonary circuit. In fact, the heart in advanced tuberculosis, after years of tachycardia, and mixed infections of all kinds, associated with continued pyrexia...frequently presents no enlargement, and examples of typical heart failure, even in these circumstances, are excessively rare.

**ELECTROCARDIOGRAPHY OF THE
HEART IN TUBERCULOSIS.**

ELECTROCARDIOGRAPHY OF THE HEART IN PULMONARY
TUBERCULOSIS.

From the foregoing synopsis of the symptomatology of the cardiovascular system in pulmonary tuberculosis, it would appear that neither clinical nor radiological investigations are capable, in themselves, of supplying adequate information as^{to} the exact state of the heart, in the absence of gross pathological changes, and so people turned to the electrocardiograph, and it is in this field of study that there has been greater uniformity of findings and conclusions. As Sir Thomas Lewis¹⁷ puts it, "Electrocardiography is the last court of appeal, and its judgment is, practically speaking, infallible."

Throughout different parts of the world, various workers have been drawn to this field of study, and the literature contains records of some 1445 cases of pulmonary tuberculosis, which have had an electrocardiographic examination made, and recorded. Some of these series have had no other form of cardiac examination made, and are consequently of less value than others, but, on the whole they are suited for purposes of comparison. To the previous number, an additional 45 cases are now added, in which all the forms of investigation under consideration, have been conducted. The information gained, has served

to confirm the findings of others, and to show the limits we may expect from such study. In addition, the relationship existing between electrocardiographic and clinical findings, and other factors, such as age, sex and type of occupation, has been demonstrated.

Types of Electrocardiographic Abnormality.

In pulmonary tuberculosis, electrocardiographic abnormalities are commonly one or more of the following:-

- (a) axis deviation.
- (b) fall of voltage.
- (c) inversion of the T waves.

I. Axis Deviation.

In many cases deviation of the cardiac axis to the right denotes hypertrophy of the right sided chambers of the heart. In such cases it may be assumed that this condition is secondary to pathological changes in the pulmonary circulation, in which the right heart is called upon to exert an increased effort over a prolonged time. A certain amount of care is necessary in assuming that absence of right axis deviation excludes such hypertrophy

of the right heart. In cases where there is hypertrophy of the left heart, in conjunction with hypertrophy of the right heart, the cardiac axis may show no deviation in either direction. It must also be borne in mind that the electrical axis of the heart is influenced by the anatomical axis, so that cardiac displacement may give rise to electrical deviation; thus a horizontal position of the heart, associated with a high diaphragm may mask an electrical deviation to the right, whereas a more vertical position of the heart, as seen in asthenic subjects with low diaphragms, will tend to produce right axis deviation.

II. Fall of Voltage.

As experience in the interpretation of electrocardiograms increases, more significance is being attached to a fall in voltage below normal, the modern conception being to regard as abnormal or pathological, cases showing 7 millimetres or less, between the summit of the R wave and the lowest point of the S wave, regard being had to the permanency of the finding. In the absence of either the R wave or the S wave, a height or depth in the other of 7 millimetres or less, is likewise considered pathological.

Russell and Cassidy¹⁸ conclude that such low voltage findings denote a degree of myocardial degeneration such as necessitates a guarded prognosis; and that, on the whole, the lower the voltage, the worse the prognosis.

Transitory low voltage is of less significance prognostically, and occurs typically in coronary occlusion, acute rheumatism, diphtheria, and other toxic states.

Herein then, lies one of the most valuable findings obtainable by the electrocardiogram, in that low voltage may be the only clue to a pathological condition of the myocardium, in a patient, otherwise devoid of abnormal cardiovascular signs and symptoms, with the possible exception of persistent tachycardia.

III. Inversion of T Waves.

Shallow inversion of the T wave in lead III is met with in a proportion of healthy subjects, and so is not considered to be pathological. Furthermore, the opinion is now held that the amplitude of the T wave decreases in inverse proportion to age. Otherwise, inversion of the T wave may be regarded as being of some pathological

import, or at least highly suggestive of impairment of cardiac nutrition, or of actual myocardial degeneration.¹⁹ Patients under the full effect of digitalis may show absence of, or depression of, the T wave, but with this condition, one is not now concerned.

Lewis²⁰ claims that, at present, too little is known of the exact significance of inversion of the T wave for prognostic purposes. Nevertheless statistical studies have shown that the "expectation of life" figure in life-tables, is much reduced below the average, in individuals whose electrocardiograms show inversion of T waves.²¹ Further statistics, based upon the groups quoted below, have shown a uniform high mortality, but it is possible that cases of coronary occlusion, and bundle-branch block have been included, and further study in this field might amply reward the time devoted to it.

Inversion of the T wave, apart from the two forms mentioned above, occurs in one of four ways, each of which is pathological:-

- (a) In LEAD I.
- (b) In LEADS I & II.
- (c) In LEADS II & III.
- (d) In LEADS I, II & III.

Inversion of the T wave in Lead II alone, does not occur, neither should it occur in Leads I and III, without also

occurring in Lead II.

In the course of this study it has been suggested that there is more than one possible factor which may adversely affect the heart in pulmonary tuberculosis. Reference has also been made to the hypothesis that certain types of heart may either directly predispose to pulmonary tuberculosis, or else operate in the production of a lowered resistance to this disease. The information obtained does not appear to lead to a very conclusive perception of the precise mechanism of those changes which do occur. Certain types of change do, however, appear to be secondary to the pulmonary lesion, and in these the condition of the heart is not of prime importance, since, when the pulmonary functioning capacity remains adequate, the heart, in fact, rarely fails, with the exception of the right sided failure of the last stages of the disease, which probably results from a rise of intrapulmonary blood pressure.

It would seem pertinent therefore, at this stage, to summarise what is known at present of the pulmonary

circulation, and the effects following pathological changes therein. Such a summary will be considered from the physiological, experimental and clinical aspects.

PHYSIOLOGY OF THE PULMONARY CIRCULATION.

THE PHYSIOLOGY OF THE PULMONARY CIRCULATION.

The present views of the physiology of the pulmonary circulation are represented briefly in the following paragraphs.

Arising from the pulmonary artery, there exists in the lungs a very extensive vascular bed. By far the greater part of the blood in the lungs comes from this source, the much smaller source of supply being that which is derived from the systemic system, via the bronchial arteries. In spite of a limited amount of anastomosis, probably only a very small amount of bronchial blood ever reaches the alveolar capilleries.

The mean blood pressure in the pulmonary artery, normally does not exceed some 15 - 20 millimetres of mercury, or about one sixth of the pressure within the aorta; the resistance to outflow is very slight. The effect of raised blood pressure in the pulmonary artery upon the heart is very severe, causing enormous right sided enlargement, and very dusky cyanosis, as is best exemplified in Ayerza's disease, a comparatively rare condition of which some 100 cases have been reported in the literature.²²

The pressure within the pulmonary artery depends upon the output of the right ventricle, and upon the resistance met with in the lungs. The venous pressure is low....almost at zero, so it follows that there is a steep "gradient" between arterial and venous pressures, which is to be expected in view of the high velocity of blood in the pulmonary circulation. Increase of output from the right ventricle has some effect upon the arterial pressure, but practically none on the venous pressure, since the left auricle is nearly always competent to drain the veins. Thus it comes about, that, in increased ventricular output, the pressure gradient becomes even steeper than normal.

It can be shown that changes of pressure in the systemic system are frequently accompanied by changes of pressure in the pulmonary circulation. In experiments where the venous inflow to the heart has been kept constant, this phenomenon still holds, showing that the theory of "back-pressure" is probably not tenable unless in the presence of incompetence of the mitral valve..... the operating factor being, as it were, a "vis a tergo", thus justifying the well known clinical benefit of venesection in pulmonary congestion. The hypothetical

explanation is that the increased systemic pressure causes an increased blood supply to the heart, through the coronary arteries, and thereby stimulates both ventricles towards a larger output of blood.

Changes of resistance in the pulmonary circulation are, to a certain extent, under the control of vasoconstrictor and vasodilator nerves, the former being of sympathetic origin, and the latter probably being derived from the vagus nerves, and partially from the parasympathetic system. Constriction or dilatation is therefore to some extent under nervous control, although it is uncertain how far this control is operative.

Anrep and Bulanatno²³ have demonstrated heart-lung preparation tracings in which it can be shown that arterial blood pressure varies during respiration, viz. there is a rise of pressure during inspiration and a fall during expiration. The synchronism of the rise and fall with the phases of the respiratory excursion is not exact....the rise continuing with the beginning of expiration and the fall continuing into inspiration. During the rise which accompanies inspiration, there may be acceleration of the heart beat, caused by increased

filling of the right heart by aspiration of blood during inspiration.

Under normal conditions, the lungs are in a constant state of stretch, so tending to collapse, and therefore exerting a pull on the thoracic wall, which in return exerts an equally strong pull on the lungs, via the pleurae. When air is admitted into the pleural cavity, such collapse occurs. During inspiration, the pull of the lungs becomes stronger, thereby increasing the negative pressure within the pleural cavity. This pressure, in turn, exerts an influence on all intrathoracic viscera, including the heart and great vessels. Blood always flows from a higher, to a lower pressure. Consequently, on inspiration, blood must tend to flow from the periphery towards the thorax, the thin walled veins being relatively more affected than the less distensible arteries. The net result is that the venous return to the heart becomes increased, especially on the right side. During inspiration, therefore, the inflow into, and the output from the right side of the heart, is more rapid than during expiration, and consequently the arterial blood pressure will be raised. The respiratory descent of the diaphragm will add still further to this effect by increasing intra-abdominal pressure, thus

driving more blood towards the centre. Lewis²⁴ puts forward the view that the influence of the movements of the thorax upon the heart, transmitted via the pericardium, play an equal, if not an even greater part, in the production of those changes of pressure occurring during the respiratory excursion.

**RECENT EXPERIMENTAL AND
OTHER CONSIDERATIONS.**

RECENT EXPERIMENTAL AND OTHER CONSIDERATIONS OF
THE PULMONARY CIRCULATION IN RELATION TO THE HEART.

The subject of intrapulmonary blood pressure has been largely studied in the experimental animal.

Moore and Binger²⁵ made extensive observations on the effects of resistance to the flow of blood, to and from the lungs. They used the method of compression of the pulmonary artery in dogs, by the inflation of a previously inserted rubber bag. By this method, they were able to demonstrate that, only just before death, was there any increase of respiratory rate. A precisely similar result was obtained on compression of the pulmonary vein. An increase in the size of the X ray shadow of the heart was obtained on compression of the capillaries and arterioles of the lung.

These findings bear out the observations of Schlaepfer²⁶ who showed that, upon ligation of the pulmonary artery, collateral circulation was fairly rapidly established through the bronchial vessels, and that the resulting fibrosis was slight. Upon section of the phrenic nerve, however, the situation changed in that collateral circulation was poorly developed, and

fibrosis was extensive and rapid, thus showing that simple ligation, without phren^{ic}ectomy, would be of little avail in an attempt to produce fibrosis, for example, in a tuberculous lung. He, also, was able to demonstrate right sided cardiac hypertrophy as the result of obstruction to the pulmonary circulation.

In 1921, Wiggers²⁷ made a most extensive review of all known work on the pulmonary circulation. In his conclusion, he states that the normal pressure within the pulmonary artery varies between a minimum of 6 to 21 millimetres of mercury, and a maximum of 60 to 30 millimetres....representing the lowest diastolic figure in the former and the highest systolic in the latter. The range of his figures exceeds those of previous workers. Pressure within the pulmonary artery depends, according to this worker, upon

- (a) the minute output of the heart, determined by the heart rate and the systolic discharge;
- (b) the pulmonary capillary resistance;
- (c) the viscosity of the blood; and
- (d) the resistance of the mitral valve.

He found further, that, beyond a slight rise of pressure, on sympathetic stimulation, the nervous system

exerted but little control over the pulmonary blood pressure. Vagal stimulation was found to increase the pulmonary circulation time. There did not appear to be any chemical regulation. He concluded that regulation of the output of the heart was due to a reflex mechanism, the possible stimulus being venous pressure.

A further study of the circulation through the lungs was made by Underhill,²⁸ who found that ligation of the pulmonary artery caused an increase in pulmonary blood pressure of 30 to 60%, but that the ill effects suffered consisted only of tachypnoea, and a fall in Oxygen Saturation of Blood to about 70%, which could only be raised to 90% with artificial ventilation. He confirmed that, after ligation, circulation was maintained by the bronchial vessels. Perhaps his most instructive experiment consisted in removal of one lung from the circulatory bed without any demonstrable embarrassment of the heart. Both measures were followed by an increase in volume of the unaffected lung.

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**CLINICAL OBSERVATIONS
IN ALLIED CONDITIONS.**

CLINICAL OBSERVATIONS IN ALLIED CONDITIONS.

The effect of long-standing bronchial asthma upon the heart was studied by Alexander, Luton and Kountz.²⁹ Using the method of Dietlen,¹⁰ they measured the surface area of the heart by the orthodiagram and found right sided cardiac enlargement to be rare. White³⁰ similarly found that electrocardiograms taken during asthmatic attacks showed no increase of right sided preponderance. Khan,³¹ on the other hand, showed an incidence of 20% right axis deviation in his series. (The hypothesis offered to explain such a discrepancy is that Left sided hypertrophy may mask right sided hypertrophy, in that the electrical axis may not show deviation toward either direction).

In Ayerza's disease, as already mentioned, there is a state of increased tension within the pulmonary artery due to sclerosis, which has frequently thought to be due to syphilis. In this condition there is much right sided cardiac hypertrophy with myocardial fibrosis and fatty infiltration. Radiologically the heart presents the boot shaped shadow known as "coeur en sabot"...with a large pulmonary conus. Here the electrocardiogram shows marked right axis deviation.

Moschcowitz³² has perhaps made the most extensive study of the clinical relationship between the pulmonary circulation and circulatory states, in which he refers to the "dynamic" relationship between pulmonary congestion and right sided heart failure. According to his views arteriosclerosis of the pulmonary circulation occurs in the following conditions:-

- (a) Mitral disease.
- (b) Emphysema.
- (c) Diminished lung-volume in
 - (1) Chronic Pulmonary Tuberculosis,
 - (2) Chronic interstitial pneumonia,
 - (3) Neoplasms of lungs or mediastina.
- (d) Kyphoscoliosis.
- (e) Obliteration of the pleurae.
- (f) Patent ductus arteriosus, and other congenital lesions.

Among the changes noted as the result of the above conditions are:-

- (a) Increased venous pressure.
- (b) Cyanosis.
- (c) Hypertrophy or dilatation of the right side of the heart.
- (d) Accentuation of the second sound at the pulmonary area.
- (e) Other signs of congestive heart failure, including pulmonary oedema.

Paul White,³³ on the other hand, finds only a "functional and anatomical" relationship of the heart and lungs, and an "etiological" dissociation. According to his views, strain is thrown upon the right side of the heart in:-

- (a) Lobar pneumonia,
- (b) Broncho-pneumonia,
- (c) Whooping cough,
- (d) Chronic bronchitis,
- (e) Bronchiectasis,
- (f) Emphysema.

At the same time he believes that the heart remains unaffected in:-

- (a) Pulmonary Tuberculosis,
- (b) Bronchial asthma,
- (c) pulmonary abscess,
- (d) syphilis,
- (e) malignant disease of lungs,
- (f) massive collapse,
- (g) infarction.

In each of these conditions, exception may be made in the case of very advanced disease, where so much of the lung tissue is involved that intrapulmonary arterial pressure is raised and the right ventricle overburdened. These statements are made, however, "ex cathedra."

It will thus be seen that among clinicians there exists a good deal of controversy as to the effect of different types of pulmonary change upon the heart.

From these physiological, experimental, and clinical observations, it is seen that, although lesions, amounting in total to removal of one lung from its sphere of activity, produce some cardiovascular results, these results are by no means striking, and are, in fact, much less important than might have been anticipated. On the whole, the results of various workers show much similarity, although it is not always possible to reconcile the findings of one with another. The general trend is borne out in the clinical findings after artificial pneumothorax, which, once it has been successfully established, appears to embarrass the patient but little. The same may be said, with a certain amount of reservation, of thoracoplasty, and even bilateral artificial pneumothorax is not often accompanied by great discomfort. Subtotal, and total pneumonectomy have now been performed for various reasons, in a few cases in this country and elsewhere, but it is, as yet, too early to assess the results of these procedures.

All the evidence at present available goes to show that various forms of collapse therapy, employed in the

treatment of pulmonary tuberculosis, are not likely to produce cardiac embarrassment and there is also sufficient evidence to suggest that, on the whole, such alteration as may be shown electrocardiographically after various forms of collapse therapy, seldom need cause any great anxiety. Nevertheless, a certain proportion of patients, after thoracoplasty, do suffer great cardiac embarrassment. The assessment of those factors leading to this mishap constitute a study in themselves, although it is hoped that the present investigation may shed some light on this particular subject.

By far the greater bulk of evidence, then, is against the view that the heart is affected adversely in pulmonary tuberculosis, because of changes in the pulmonary circulation. If the heart is affected by such means, the mode of operation must be excessively insidious, and quite unlike that which is seen in allied conditions, or which may be produced experimentally.

**REVIEW OF SIMILAR INVESTIGATIONS
BY OTHER WORKERS.**

REVIEW OF SIMILAR INVESTIGATIONS BY OTHER WORKERS.

In order to compare the findings in the present series of cases, an exhaustive review of the literature has been made. It appears that some eight such investigations have been reported from time to time in other parts of the world.

I. Boas and Mann.

The earliest record of a systematic electrocardiographic study of the heart in pulmonary tuberculosis is to be found in the work of Boas and Mann,³⁴ who, in 1921 studied 97 cases. They found that 41% of their cases showed no cardiovascular abnormality. In 29%, they found right ventricular preponderance, and in 30%, left ventricular preponderance. They were unable, however, to relate right ventricular preponderance with any particular degree or type of pulmonary lesion, nor was it of more frequent occurrence in conjunction with fibroid phthisis, or pleurisy. The incidence of right ventricular preponderance was greater among males than females, and among young patients than elderly patients, in whom left ventricular preponderance occurred with greater frequency.

II. Simon and Baum.

Perhaps the most valuable series of cases was presented by Simon and Baum in U.S.A. in 1928. They studied 250 cases of pulmonary tuberculosis, and concluded that electrocardiographic records were of value in this condition, allowing of earlier diagnosis of cardiac involvement, than by other methods of examination. They were also able to demonstrate the absence of any constant change after collapse therapy. They found that low potential occurred in leads I and III in conjunction with "dropped heart." Throughout their entire series they found that the average height of the T waves was lower than normal.

TABLES SHOWING THE AVERAGE HEIGHTS OF THE T WAVES.

Taken from Table by Lewis and Gilder of the Deflections in Normal Electrocardiograms in 52 healthy subjects.

TABLE II.

		P	R	S	T
I	Minimum	trace.	15.0x	0.	-0.5
	Average	0.52	5.16	2.06	1.93
	Maximum	1.0	12.0	6.0	5.5
II	Minimum	trace	4.0	0.	trace
	Average	1.16	10.32	2.23	2.46
	Maximum	1.7	16.5	4.5	5.0
III	Minimum	trace	2.0	0.	-2.0
	Average	0.81	6.61	1.73	0.61
	Maximum	1.5	14.0	4.0	3.0

Table from Simon and Baum. 250 cases of Pulmonary tuberculosis.

TABLE III.

		P	R	S	T
I	Minimum	0.	0.	0.	0.
	Average	0.41	5.2	2.2	1.4
	Maximum	2.0	25.0	15.0	4.0
II	Minimum	0.	1.0	0.	0.
	Average	1.4	10.8	3.8	1.6
	Maximum	5.0	33.0	18.0	6.0
III	Minimum	0.	0.	0.	0.
	Average	0.94	7.3	1.9	0.4
	Maximum	4.0	33.0	17.0	3.0

x The figure 15.0 in Table II given by the American authors is almost certainly a misquotation. I have been unable to trace their reference, but a similar table is given by Sir Thomas Lewis in "Clinical Electrocardiography" 5th edition, page 23, (Shaw and Sons Ltd.,) in which the figure reads.. 1.5 mm.⁸

Simon and Baum, in their interpretation of their records, make special note of the following points:-

- (a) The maximum voltage in any one lead.
- (b) The relation between height and direction, in the three leads.
- (c) The form of the wave or peak. .
- (d) The duration, as measured by straddle.

Throughout their series, Right ventricular preponderance occurred in 10% of all cases.

III. Anderson.

In 1929, Anderson³⁵ in U.S.A. made a study of a further series of 100 cases, of which 58 had had previous collapse therapy. He found that various collapse operations produced no constant or predictable change in the electrocardiogram. Tachycardia appeared commonly in his series. P and T waves were of less amplitude than normal. He came to the conclusion that the electrocardiogram was altered, in pulmonary tuberculosis, only in the presence of severe toxæmia.

IV. King and Hansen.

In 1930, King and Hansen⁶ in U.S.A. made a very complete cardiac survey in 100 cases of pulmonary tuberculosis, using the combined method of radiography and electrocardiography.

They measured the cardio-thoracic index in each case, and made the arbitrary division, already referred to, of:-

Asthenic cases.....in which the cardio-thoracic ratio was less than 40%.
 Sthenic cases.....in which the cardio-thoracic ratio was between 40% and 60%.
 Hypersthenic cases...in which the cardio-thoracic ratio was over 60%.

An incidence of 32% of Asthenic cases was found, as compared with an incidence of 21% in a control series of normal subjects.

They found that Low potential occurred in one or more leads in 63% of their cases.

(low potential they defined as being a deflection of less than 8 millimetres in any QRS complex. c/f definition used on page 29).

Table showing occurrence of Low Potential.

TABLE IV.

LEAD I	Asthenic Hearts. 57%	Sthenic Hearts. 38%
LEAD II	Asthenic and Sthenic Hearts. 45%	
LEAD III	Less common than in normal population.	
	Total incidence of Low potential.....63%.	

Six possible causes were offered for this finding:-

- (a) Constitutionally Asthenic Heart.
- (b) Decrease in size of the Heart, in Pulmonary tuberculosis.
- (c) Toxic effect of Tuberculosis upon the myocardium.
- (d) Altered position of the heart.
- (e) Poor nutrition of the heart.
- (f) Physical Inactivity.

Unfortunately these workers did not attempt further investigation of these six possible causes.

Table showing the incidence of Low Potential in each lead, in varying types of heart, compiled from the findings of various workers.

TABLE V.

	LEAD I	LEAD I & III	LEAD III
Asthenic group.	57%	45%	19%
Sthenic group.	38%	45%	71%
Hypersthenic group.	5%	10%	10%

King and Hansen³⁶ made a further study of 66 cases in which some form of collapse therapy had been carried out. In this series they concluded that any changes which occurred, were due to alteration in the position of the

heart...the more influential factors being pleural and mediastinal adhesions, and the less influential factors being myocardial origin.

V. Heaton.

In 1933, Heaton³⁷ in Canada made a study of 304 cases. Of these, 236...i.e. 77.63%, were normal, while 68, i.e. 22.37% were abnormal. Various types of departure from normal were found, including, low potential. In this series, there were 49 levograms and 24 dextrograms. Heaton concluded that inversion of the T wave carried a bad prognosis in pulmonary tuberculosis.

VI. Von der Weth.

By far the largest series on record is that of von der Weth³⁸ in Germany, who, in 1933 recorded an electrographic survey of 508 unselected tuberculous patients. In his report is given a comprehensive review of the effect of lung disease generally, upon circulation. On the whole, however, the findings of this worker are inconclusive, and he records that no correspondence was found between what might have been expected from clinical examination, and what was, in fact, found electrocardiographically. For example, a number of his cases showed

left ventricular preponderance when there was no clinical evidence to suggest either hypertrophy of the left ventricle, or relative weakness of the right ventricle.

Von der Weth recorded splitting of the P wave in no less than 22% of all his cases, while the P wave was biphasic in 6%. A small proportion of cases showed alteration in the conduction time of the P R interval. Only rarely did he find pathological T waves in his series. Right and left ventricular preponderance occurred with greater frequency after collapse therapy.

These investigations did not appear to be conclusive in any way, nor did there seem to be much in common with the findings of other workers. Nevertheless, in a later communication, this worker gave as his conclusion that electrocardiography indicates the occurrence of three types of cardiac change in pulmonary tuberculosis, viz:-

- (a) An Acute Toxic Type... as indicated by sinus tachycardia.
- (b) A Chronic Toxic Type.. as indicated by electrocardiographic evidence of myocardial disease.
- (c) A Mechanical Type..... in which electrocardiographic changes are due to cardiac displacement.

No mention is made of the effect of changes in the pulmonary circulation, upon the heart.

In connection with myocardial disease, von der Weth used prolongation of the P R interval as his criterion, since he believed that low potential was a valueless indication, unless it occurred in all three leads.

It is tempting to accept such attractive conclusions, since they adapt themselves very well to what might be expected, but on this worker's evidence, such conclusions can only be accepted with reservation.

VII. Matsumoto and Hoshi.

In 1933, a shorter series of cases of pulmonary tuberculosis in infants and children was studied by Matsumoto and Hoshi³⁹ in Japan. They made an electrocardiographic examination in 20 children. Unfortunately their record does not include the age and sex incidence of their patients, nor is there anything to suggest how far advanced the cases were, beyond the fact that they mention that most of their findings occurred in advanced

disease. It is not stated whether the cases were selected.

Low potential occurred in the majority of this series. Right ventricular preponderance occurred in 34%; Auricular hypertrophy was found in one case.

They concluded, perhaps justifiably, that general weakness of the myocardium was present in 45% of their cases, and in one case there was definite evidence of advanced myocardial degeneration.

Beyond the fact that this series shows that similar changes occur in children, as occur in adults, the study does not compare favourably with those previously referred to.

THE PRESENT INVESTIGATION.

THE PRESENT INVESTIGATION.

During the course of the past twelve months a series of investigations has been conducted by other workers and myself, at the Brompton Hospital, and at King's College Hospital. The object of these investigations has been to make a further study of cardiovascular affection in pulmonary tuberculosis. Consideration has been given to all the possible factors which might operate in the production of such changes, and of the means by which they might best be detected. Our work has differed from that already recorded, in that use has been made, not of one method of examination, but of every method. We have also studied the age, sex and occupational incidence of the various changes. By these combined methods an attempt has been made to bring the somewhat divergent views already quoted, more into line with each other, and with our findings. It is also hoped, that in the course of time, our findings may prove to be of some value in the perfection of choice of tuberculous patients for operative treatment.

Selection of Patients.

As far as has been possible, the patients in the present series constitute an unselected group. Exceptions

have been made only in the following circumstances:-

- (a) Where the patient was, for some reason, unlikely to remain in hospital for a sufficient period to allow of full investigation.
- (b) Where the patient's condition made it probable that operative treatment, including the induction of an artificial pneumothorax, would be instituted before completion of the investigation.
- (c) Where some purely secondary condition was thought likely to invalidate the findings.
- (d) Where the patient was admitted in a moribund condition, or remained too ill to be moved.
(as a corollary, all patients investigated were sufficiently well to be moved about).

By adhering rigidly to these exceptions, the material for investigation necessarily became limited, but it is felt that the findings are not influenced by adventitious factors, which may or may not have been included in other series.

ACCOUNT OF THE CASES INCLUDED IN THE PRESENT SERIES.

A brief account of the individual cases used in the present series follows. Attached to each case are reproductions of the appropriate radiograph and electrocardiograph. The cases are here recorded in their order of admission to hospital. In a further section, they will be classified into various groupings and an analysis made, with which to compare the present series, with the others. Thereafter, a summary of the findings will be given, and the conclusions recorded.

**ACCOUNT OF CASES
WITH X RAY PHOTOGRAPHS OF CHEST
AND ELECTROCARDIOGRAMS.**

Name. LC/1/21.
 Date of admission to hospital. 3.10.35.
 Age. 22.
 Sex. F.
 Social state. Single.
 Occupation. Cushion maker.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 1 Years. Months.
 Physical signs, respiratory system. Present. Absent.
 Tubercle bacilli in sputum. Present. Absent.

Average pulse rate. (modal) 88 /minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 110/62 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 98.4 Afebrile. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	

Transverse diameter of heart:- 4.5 inches.
 Internal diameter of thorax:- 9. inches.
 Cardiothoracic index. 50

Asthenic.	Sthenic.	Hypersthenic.
	+	

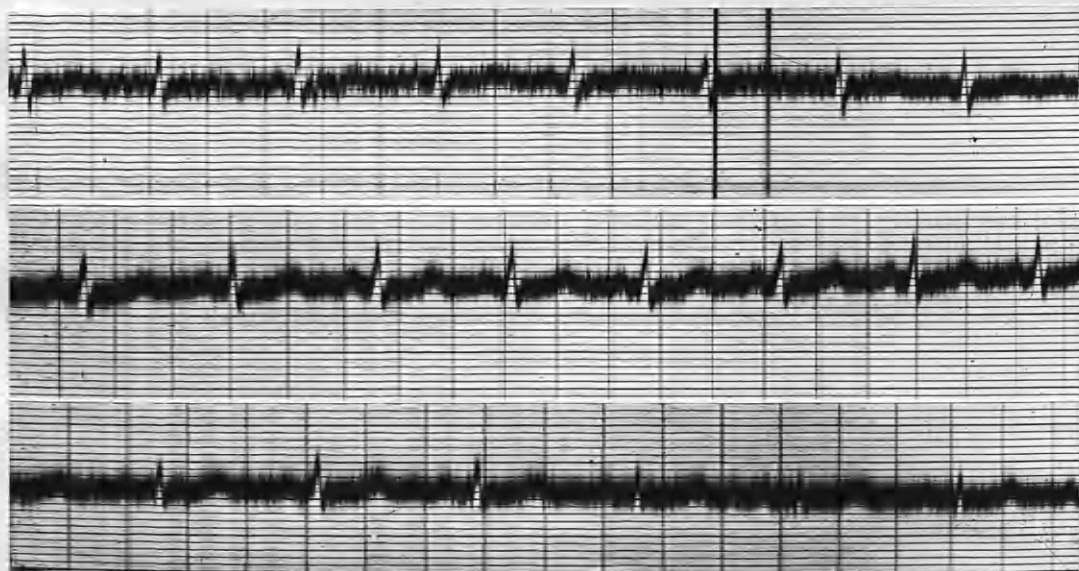
Electrocardiogram. Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	-

Remarks. There is no evidence of cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

61.



CASE LC/1/21.

Name. DS/2/33.

Date of admission to hospital. 3.10.35.

Age. 19.

Sex. F.

Social state. Single.

Occupation. Salesgirl.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms.

Years. 6 Months.

Physical signs, respiratory system.

~~Present.~~ Absent.

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 104/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 114/74 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $3\frac{3}{4}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- $4\frac{1}{2}$ inches.Internal diameter of thorax:- $10\frac{1}{4}$ inches.

Cardiothoracic index. 43.90

Asthenic.	Sthenic.	Hypersthenic.
	+	

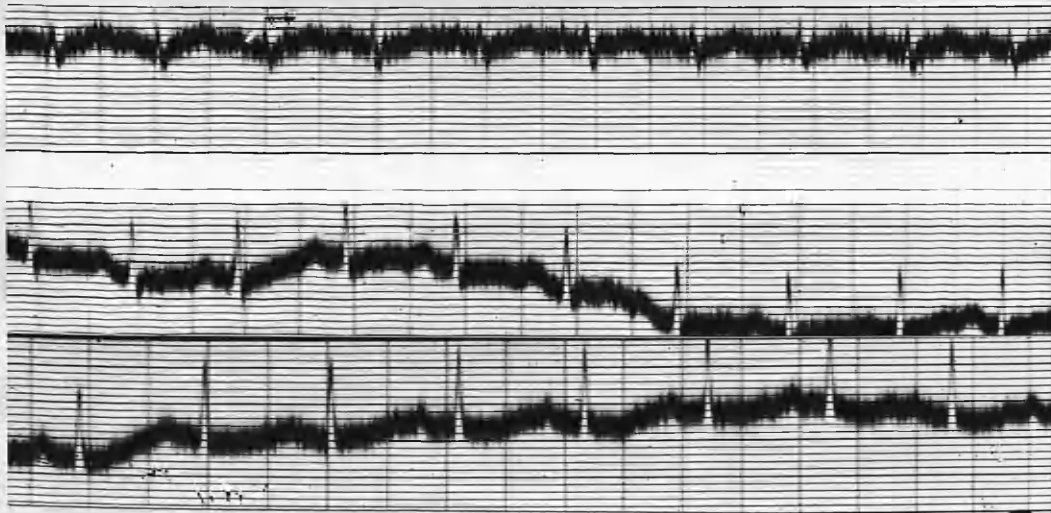
Electrocardiogram.

~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	+	-	-	-	-	-	-	-

Remarks. This is a fairly acute case. There is mild tachycardia. The electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. JW/3/36.

Date of admission to hospital. 3.10.35.

Age. 24.

Sex. M.

Social state. Single.

Occupation. Fitter.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms.

3 Years. Months.

Physical signs, respiratory system.

~~Present.~~ Absent.

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 72 /minute. regular. ~~irregular.~~

Average blood pressure. (modal) 130/74 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line.
2. Cardiac sounds. ~~pure.~~ impure.
3. Character of murmur. Pulmonic Systolic.

Average temperature. (modal) 97.2 Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- $4\frac{1}{2}$ inches.

Internal diameter of thorax:- 11 inches.

Cardiothoracic index. 40.91

Asthenic.	Sthenic.	Hypersthenic.
	+	

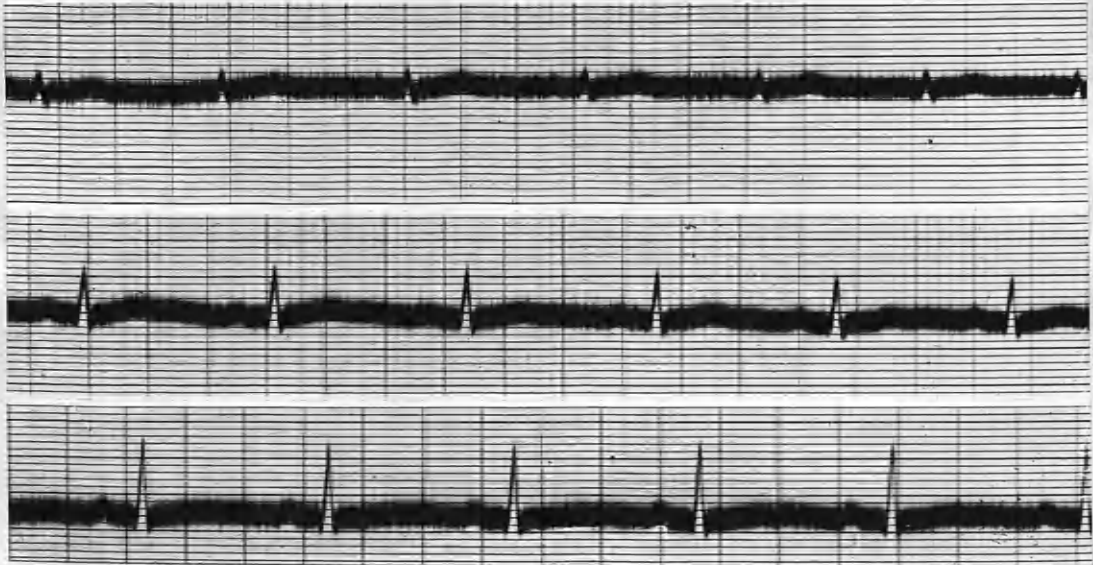
Electrocardiogram.

~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
Seconds	+	-	-	-	-	-	-	-

Remarks. The only evidence of organic involvement of the cardiovascular system is the demonstration of low voltage in Lead I in the electrocardiogram.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE JW/3/36.

Name. AV/4/34.

Date of admission to hospital. 6.10.35.

Age. 39.

Sex. M.

Social state. Married.

Occupation. Waiter.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. 18 Years. Months..

Physical signs, respiratory system. Present. ~~Absent~~.Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 82 /minute. regular. irregular.

Average blood pressure. (modal) 118/86 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in - Th. intercostal space, - inches
(from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 98.4° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- 3½ inches.

Internal diameter of thorax:- 10½ inches.

Cardiothoracic index. 33.33

Asthenic.	Sthenic.	Hypersthenic.
+		

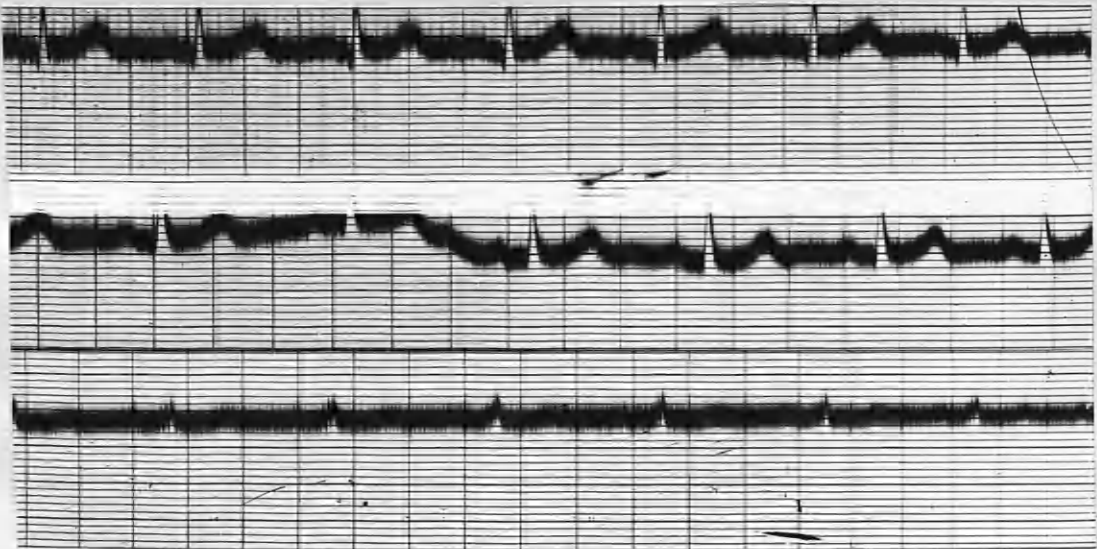
Electrocardiogram.

~~Normal~~. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	+	-	-	-	-	-

Remarks. An asthenic heart in which the electrocardiogram shows low voltage in Lead III.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE AV/4/34.

Name. SB/5/20.
 Date of admission to hospital. 8.10.35.
 Age. 24.
 Sex. M.
 Social state. Single.
 Occupation. Carpenter.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. 1 Years. 3 Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 108 /minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 126/90 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $3\frac{3}{4}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur. -

Average temperature. (modal) 97.6 Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- $4\frac{1}{2}$ inches.
 Internal diameter of thorax:- 11 inches.
 Cardiothoracic index. 41.1

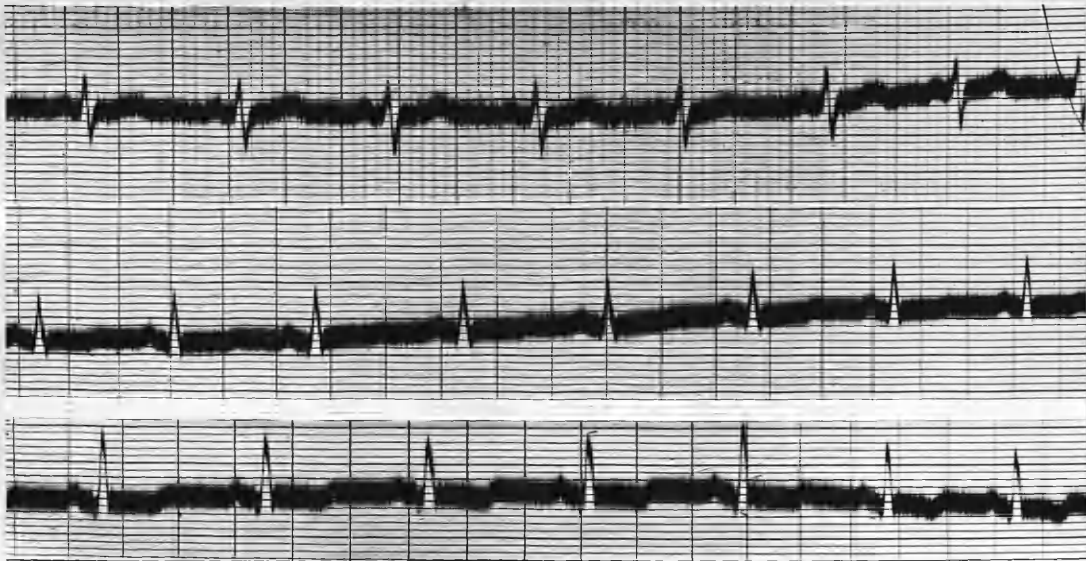
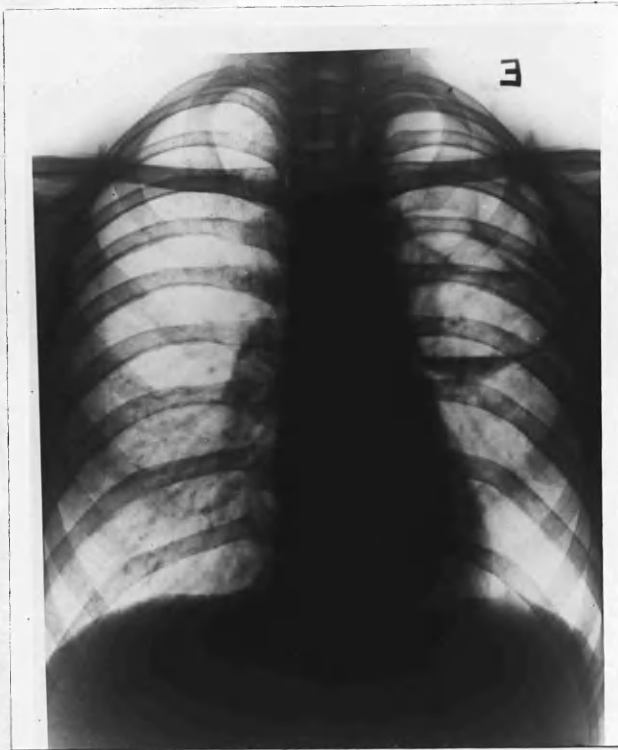
Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	-

Remarks. A case showing tachycardic but no other apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE SB/5/20.

Name. AH/6/44.
 Date of admission to hospital. 8.10.35.
 Age. 28.
 Sex. M.
 Social state. Married.
 Occupation. Clerk.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 3 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent.~~
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 84 /minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 108/74 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $4\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 99.8° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.		+
Lower.		

Transverse diameter of heart:- $3\frac{1}{2}$ inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 35

Asthenic.	Sthenic.	Hypersthenic.
+		

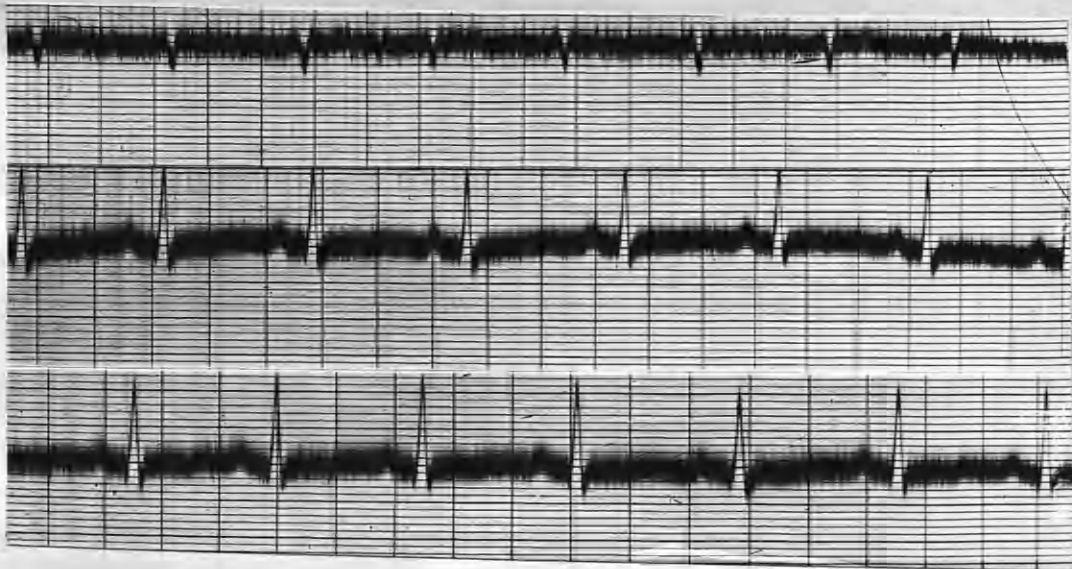
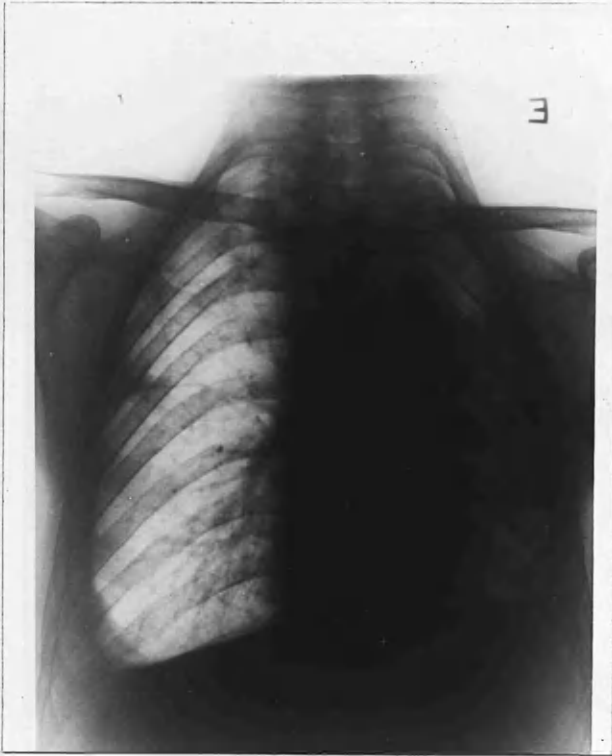
Electrocardiogram.

~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	+	-	-	-	+	-	-	-

Remarks. A case of three years' standing. There has been a recent spontaneous pneumothorax. The heart is asthenic and the electrocardiogram shows deviation of the cardiac axis to the Right. Reproductions of X Ray plates, and electrocardiogram are given on the following page.

71.



CASE AH/6/44.

Name. RM/7/32.

Date of admission to hospital. 10.10.35.

Age. 26.

Sex. F.

Social state. Single.

Occupation. Weaver.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms.

4 Years. Months.

Physical signs, respiratory system. ~~Present.~~ Absent.Tubercle bacilli in sputum. Present. ~~Absent.~~Average pulse rate. (modal) 100/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 116/74 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $2\frac{3}{4}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 99.4° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- $4\frac{1}{2}$ inches.Internal diameter of thorax:- $9\frac{3}{4}$ inches.

Cardiothoracic index. 43.15

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram.

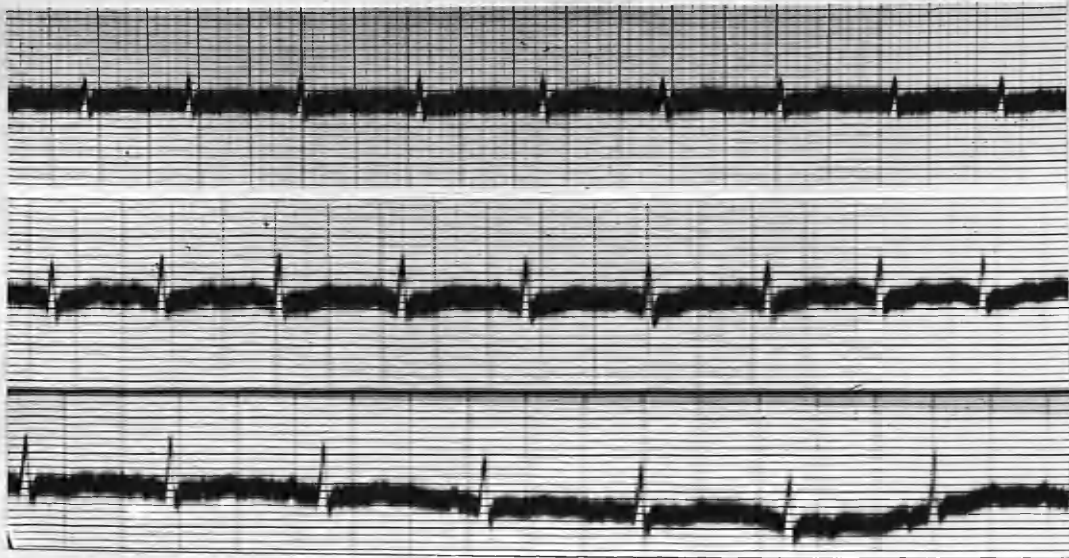
~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	+	-	-	-	-	-	-	-

Remarks. A case of some years' standing. There is mild tachycardia. The electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

73.



CASE RM/7/32.

Name. MS/8/41.
 Date of admission to hospital. 15.10.35.
 Age. 56.
 Sex. M.
 Social state. Married.
 Occupation. Fur Dresser.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 2 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent.~~
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 100/minute. regular. irregular.
 Average blood pressure. (modal) 116/78 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $4\frac{3}{4}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 96.8° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	+

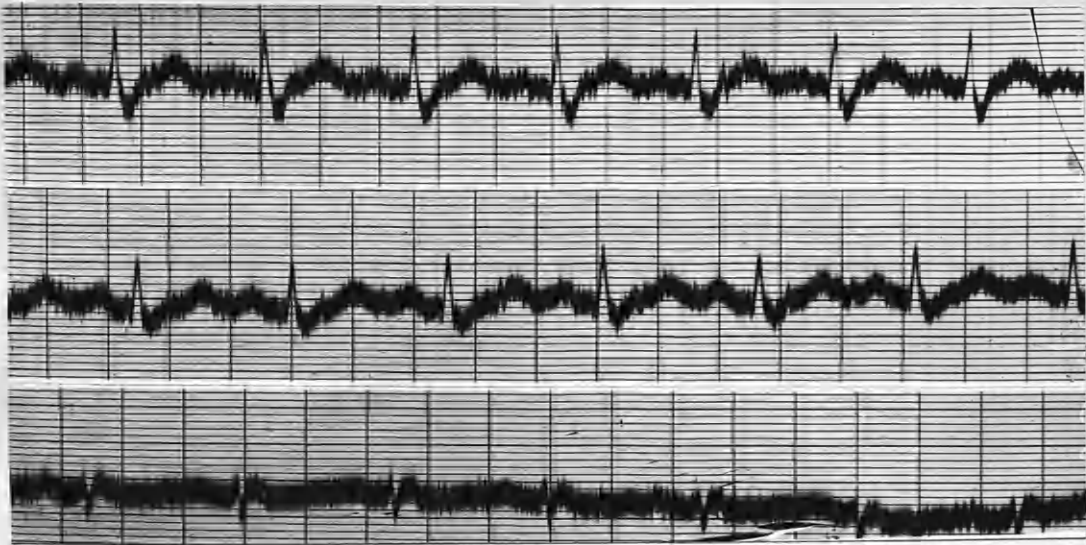
Transverse diameter of heart:- $4\frac{7}{8}$ inches.
 Internal diameter of thorax:- $10\frac{1}{4}$ inches.
 Cardiothoracic index. 47.56

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. Normal. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	+	+	-	-	-	-

Remarks. There is mild tachycardia. The electrocardiogram shows low voltage in Lead III. The cardiac axis is deviated to the left.
 Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. DB/9/29.
 Date of admission to hospital. 18.10.35.
 Age. 25.
 Sex. F.
 Social state. Single.
 Occupation. Comtometer Operator.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 3 Years. Months.
 Physical signs, respiratory system. Present. Absent.
 Tubercle bacilli in sputum. Present. Absent.

Average pulse rate. (modal) 84 /minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 138/96 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 97.6° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.		
Lower.		+

Transverse diameter of heart:- $4\frac{1}{4}$ inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 42.5

Asthenic.	Sthenic.	Hypersthenic.
	+	

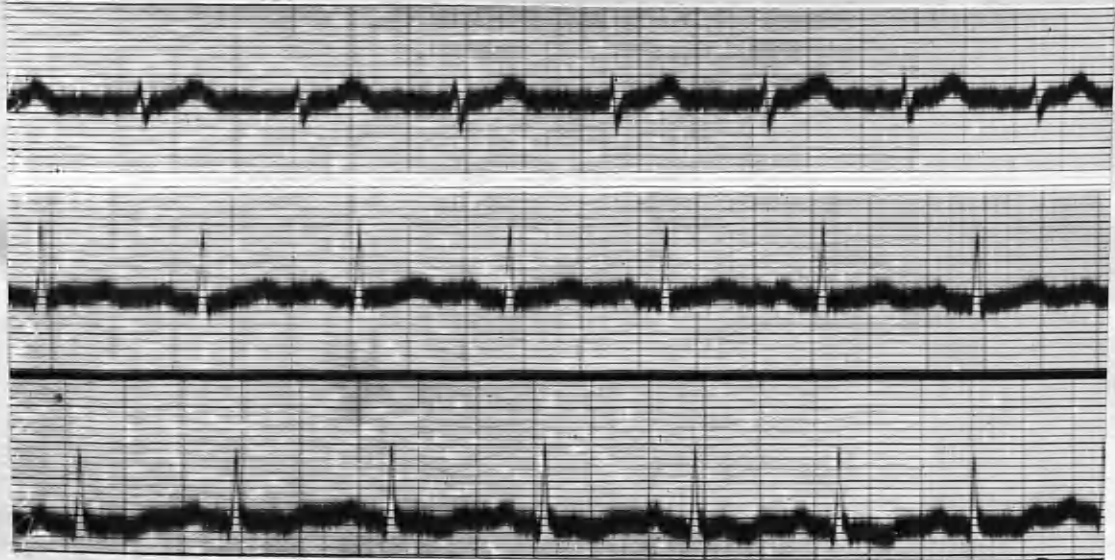
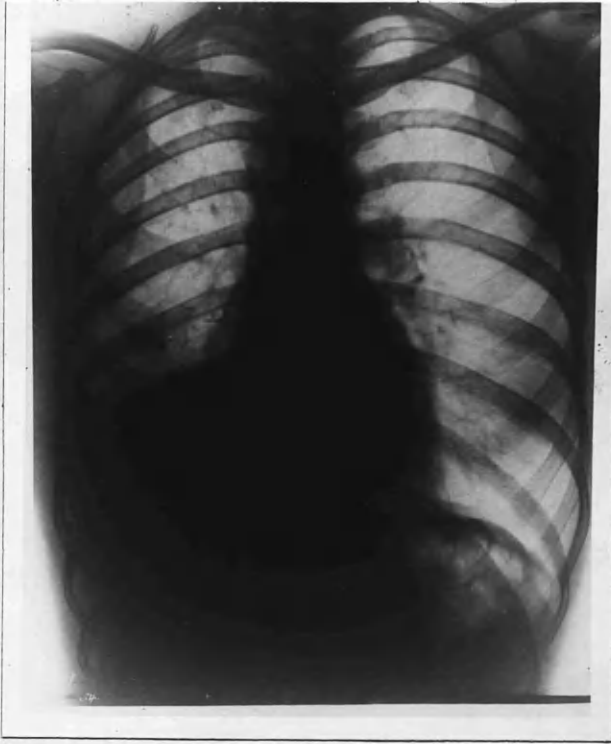
Electrocardiogram.

~~Normal~~. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	+	-	-	-	-	-	-	+

Remarks. The electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. ET/10/37.
 Date of admission to hospital. 30.10.35.
 Age. 20.
 Sex. F.
 Social state. Single.
 Occupation. Laundress.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. 1 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. ~~Present~~. Absent.

Average pulse rate. (modal) 116/minute. regular. irregular.
 Average blood pressure. (modal) 108/78 millimetres of mercury.
 Physical signs, cardiovascular system:-
 1. Apex impulse in V. Th. intercostal space, $2\frac{1}{2}$ inches
 (from midsternal line).
 2. Cardiac sounds. pure. ~~impure~~.
 3. Character of murmur.

Average temperature. (modal) 97.8 Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	+

Transverse diameter of heart:- $3\frac{3}{8}$ inches.
 Internal diameter of thorax:- $9\frac{1}{2}$ inches.
 Cardiothoracic index. 35.32

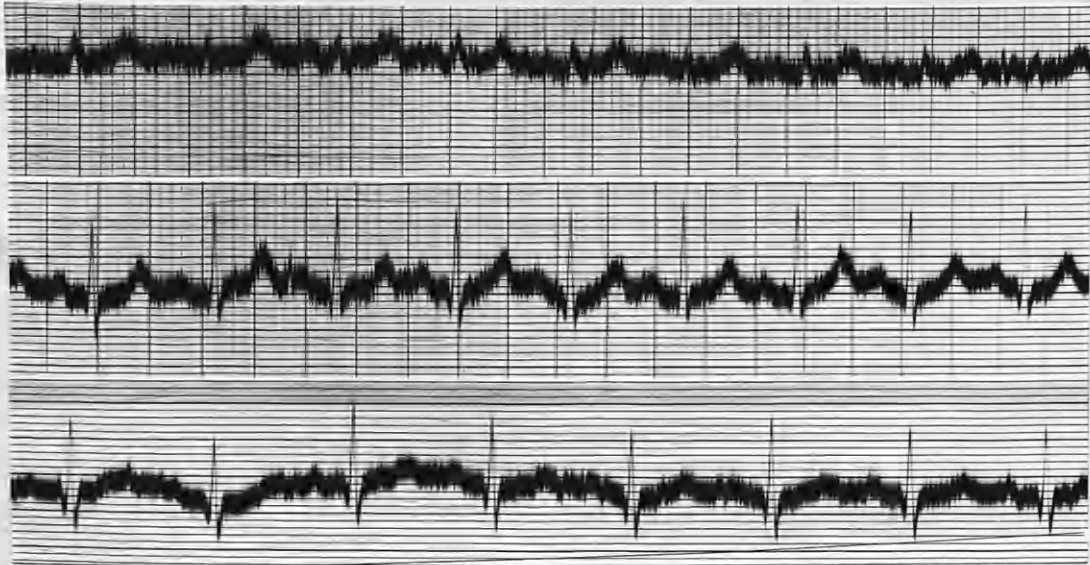
Asthenic.	Sthenic.	Hypersthenic.
+		

Electrocardiogram. ~~Normal~~. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	+	-	-	-	-	-	-	-

Remarks. There is mild tachycardia and the heart is asthenic.
 The electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. WU/11/22.

Date of admission to hospital. 30.10.35.

Age. 52.

Sex. M.

Social state. Married.

Occupation. Veterinary Surgeon.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 14 Years. Months.

Physical signs, respiratory system. Present. ~~Absent.~~Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 112/minute. regular. irregular.

Average blood pressure. (modal) 116/82 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $4\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 101° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- $4\frac{1}{2}$ inches.

Internal diameter of thorax:- 10 inches.

Cardiothoracic index. 42.5

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	-	-	-	-	-	-

Remarks. A long standing case showing tachycardia but no other cardiovascular change.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

81.



CASE WU/11/22.

Name. AB/12/40.
 Date of admission to hospital. 5.11.35.
 Age. 21.
 Sex. F.
 Social state. Single.
 Occupation. Hairdresser.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 5 Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 92/minute. ~~regular.~~ irregular. \bar{x}
 Average blood pressure. (modal) 120/72 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, inches
(from midsternal line.)
2. Cardiac sounds. pure. ~~Impure.~~
3. Character of murmur.

Average temperature. (modal) 97° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.		+
Lower.		

Transverse diameter of heart:- 4½ inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 45.0

Asthenic.	Sthenic.	Hypersthenic.
	+	

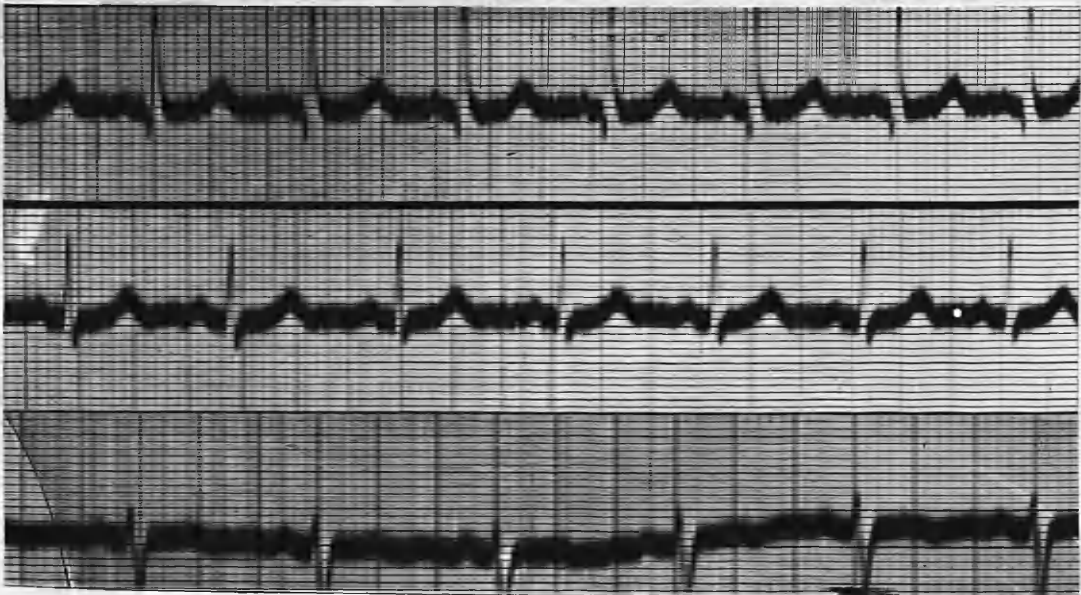
Electrocardiogram.

~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	+	-	-	-	-

Remarks. The heart is irregular and there is mild tachycardia.
 The electrocardiogram shows left axis deviation.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE AB/12/40.

Name. ID/13/35.
 Date of admission to hospital. 6.11.35.
 Age. 22.
 Sex. F.
 Social state. Single.
 Occupation. Civil servant.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 6 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 116/minute. regular. irregular.
 Average blood pressure. (modal) 118/74 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in IV Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 99.2° Afebrile. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	+

Transverse diameter of heart:- $4\frac{1}{2}$ inches.
 Internal diameter of thorax:- $9\frac{3}{4}$ inches.
 Cardiothoracic index. 46.15

Asthenic.	Sthenic.	Hypersthenic.
	+	

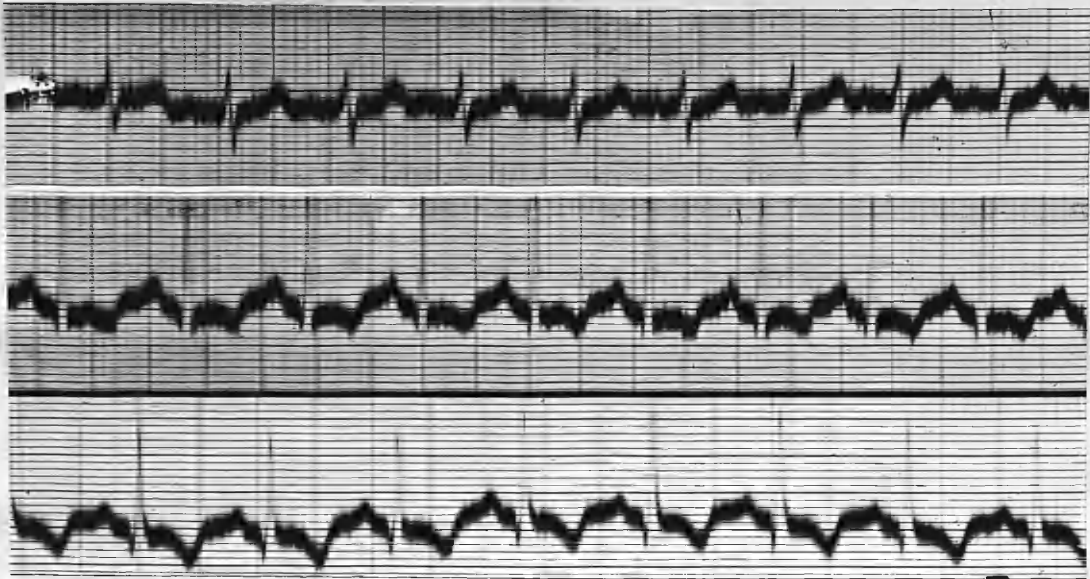
Electrocardiogram.

~~Normal~~. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
7/50 Seconds	-	-	-	-	-	-	+	+

Remarks. A case of some years' standing. There is tachycardia. The electrocardiogram shows inversion of the T wave in Leads II and III.
 Reproductions of X Ray plates, and electrocardiogram are given on the following page.

85.



CASE ID/13/35.

Name. BH/14/19.
 Date of admission to hospital. 6.11.35.
 Age. 15.
 Sex. F.
 Social state. Single.
 Occupation. Schoolgirl.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 6 Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. ~~Present.~~ Absent.

Average pulse rate. (modal) 120/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 122/74 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in IV.Th. intercostal space, 3 inches
(from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur. -

Average temperature. (modal) 100.5° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		
Middle.		+
Lower.		

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- 9½ inches.
 Cardiothoracic index. 42.11

Asthenic.	Sthenic.	Hypersthenic.
	+	

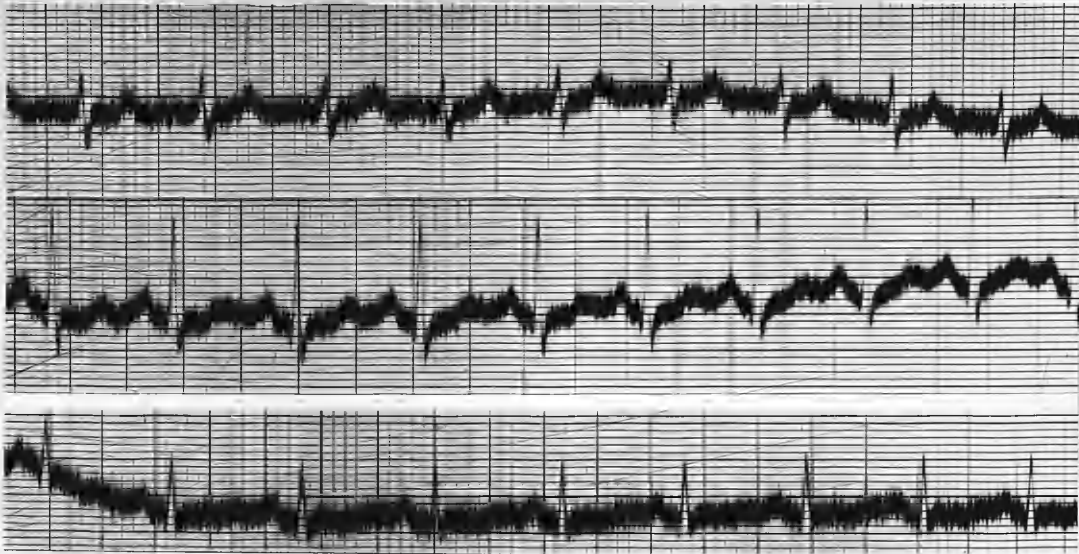
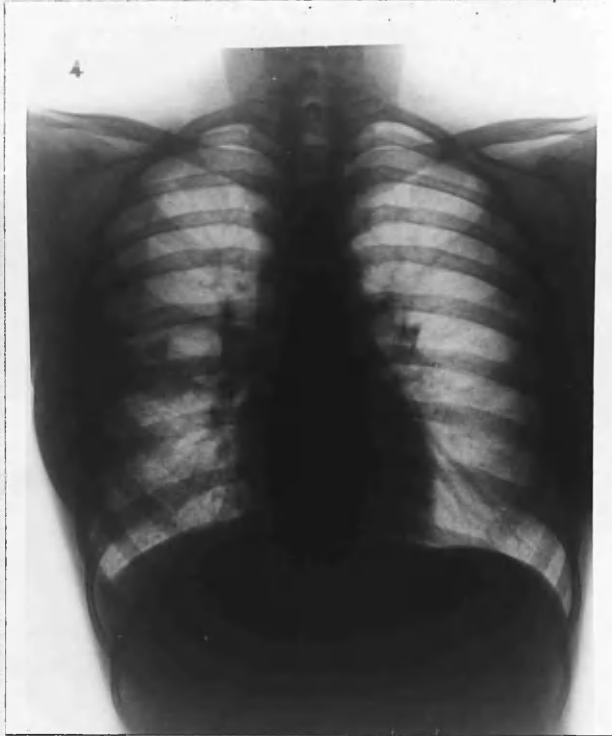
Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	-

Remarks. A young patient with marked tachycardia but no further evidence of cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. RA/15/16.
 Date of admission to hospital. 13.11.35.
 Age. 23.
 Sex. M.
 Social state. Single.
 Occupation. Traveller.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 1 Years. 3 Months.
 Physical signs, respiratory system. Present. Absent.
 Tubercle bacilli in sputum. Present. Absent.

Average pulse rate. (modal) 76 /minute. regular. irregular.
 Average blood pressure. (modal) 128/76 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~. 2nd sound at
3. Character of murmur. Pulmonic area much accentuated.

Average temperature. (modal) 98.8° Afebrile. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- 5 inches.
 Internal diameter of thorax:- $10\frac{3}{4}$ inches.
 Cardiothoracic index. 46.51

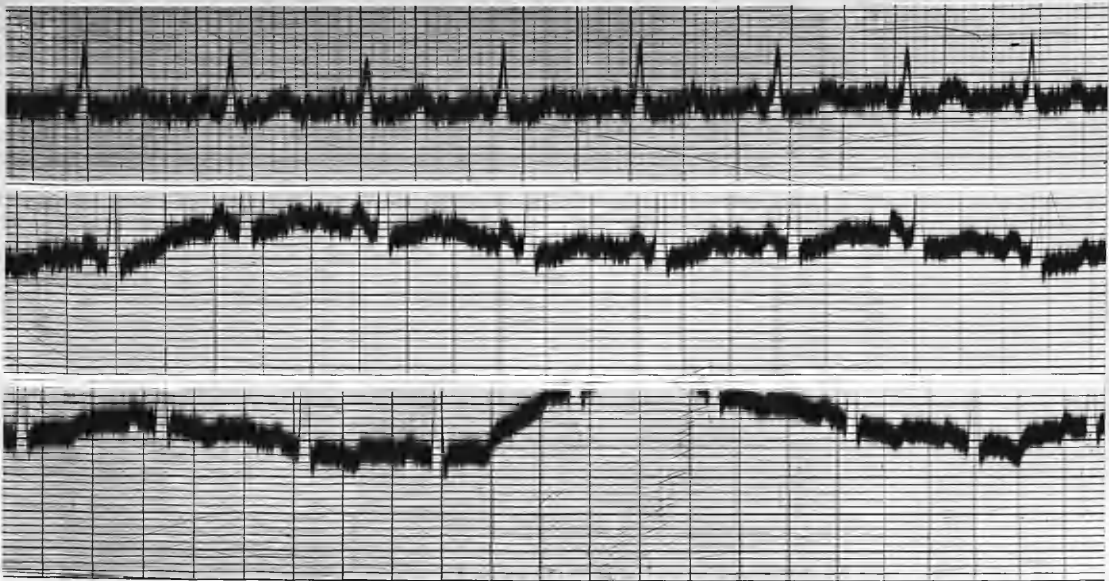
Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. (The only obtained record in this case is poor). Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	+

Remarks. There is no apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. FT/16/30.
 Date of admission to hospital. 15.11.35.
 Age. 39.
 Sex. M.
 Social state. Married.
 Occupation. Clerk.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 3 Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 76/minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 110/68 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~Impure~~.
3. Character of murmur.

Average temperature. (modal) 97.4° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- $4\frac{1}{2}$ inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 45.0

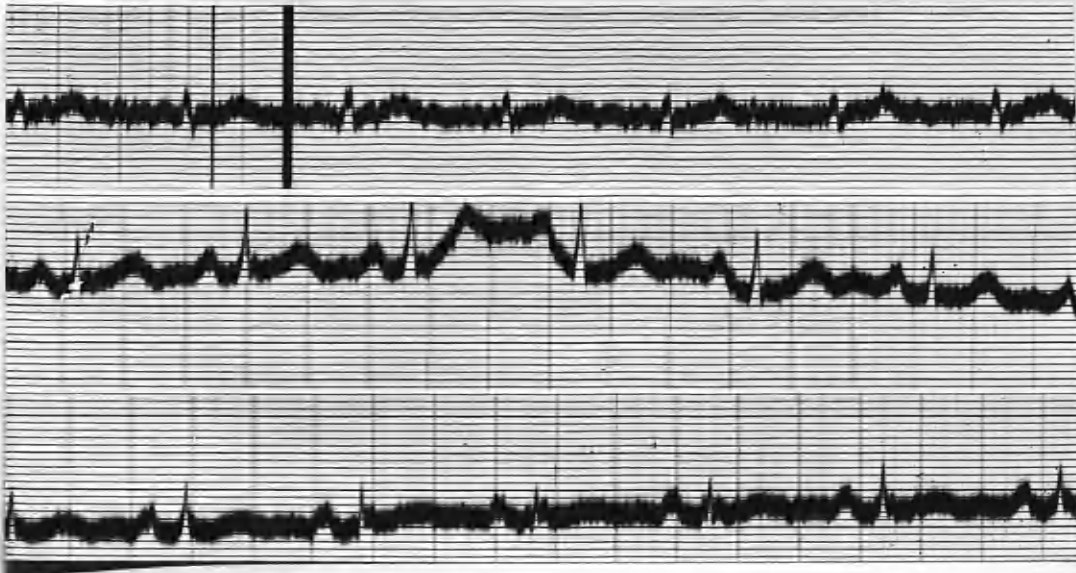
Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. (Poor tracing obtained) ~~Normal~~. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	+	-	+	-	-	-	-	-

Remarks. An acute case in which the electrocardiogram shows low voltage in Leads I and III.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. LH/17/18.
 Date of admission to hospital. 18.11.35.
 Age. 21.
 Sex. F.
 Social state. Single.
 Occupation. French Polisher.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. Years. 2 Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 100/minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 116/62 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in IV.Th. intercostal space, $2\frac{3}{4}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~. 2nd sound at
3. Character of murmur. - Pulmonic area much accentuated.

Average temperature. (modal) 99° ~~Afebrile~~. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 40.

Asthenic.	Sthenic.	Hypersthenic.
	+	

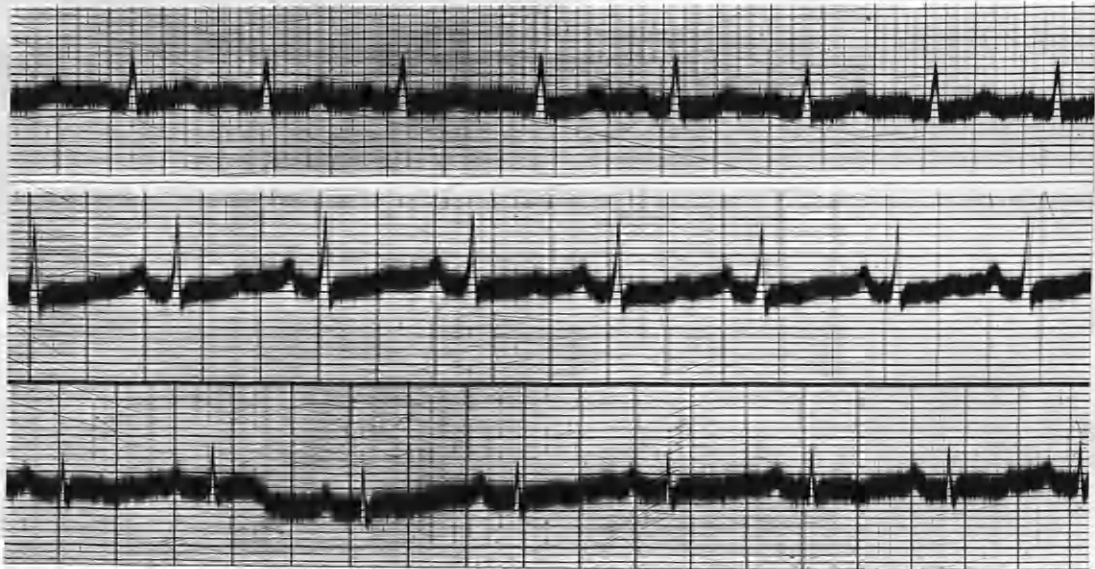
Electrocardiogram. Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25Seconds	-	-	-	-	-	-	-	-

Remarks. A fairly acute case with tachycardia but no other apparent organic change in the cardiovascular system.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

93.



CASE LH/17/18.

Name. ET/18/45.
 Date of admission to hospital. 20.11.35.
 Age. 22.
 Sex. M.
 Social state. Single.
 Occupation. Waiter.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 6 Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 118/minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 110/58 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in IV Th. intercostal space, $2\frac{1}{2}$ inches
 (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 99.4° ~~Afebrile~~. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	+

Transverse diameter of heart:- $3\frac{7}{8}$ inches.
 Internal diameter of thorax:- $10\frac{1}{2}$ inches.
 Cardiothoracic index. 36.90

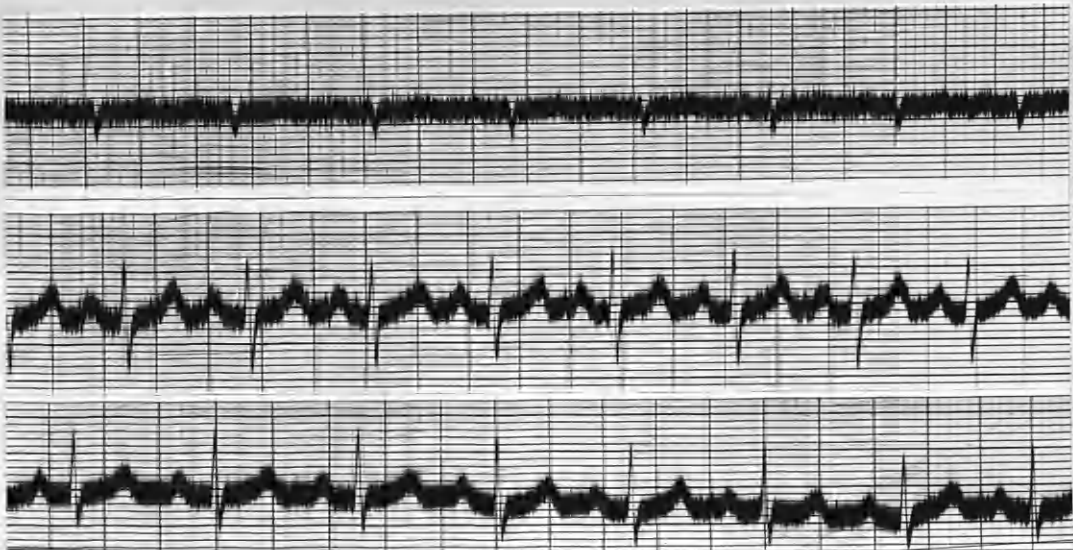
Asthenic.	Sthenic.	Hypersthenic.
+	-	-

Electrocardiogram.

~~Normal~~. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	+	-	-	-	+	-	-	-

Remarks. An acute case with extensive pulmonary involvement. There is tachycardia. The electrocardiogram shows low voltage in Lead I; the cardiac axis is deviated to the Right. Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. GO/19/17.
 Date of admission to hospital. 26.11.35.
 Age. 33.
 Sex. M.
 Social state. Married.
 Occupation. Woodworker.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. Years. 6 Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. ~~Present.~~ Absent.

Average pulse rate. (modal) 76/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 116/66 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 99.4° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.		+
Lower.		

Transverse diameter of heart:- 5 $\frac{1}{4}$ inches.
 Internal diameter of thorax:- 11 $\frac{1}{2}$ inches.
 Cardiothoracic index. 46.65

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
Seconds								+

Remarks. There is a tendency to low voltage in lead I, but it is not maintained throughout. Otherwise there is no apparent cardiovascular involvement.
 Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. AR/20/31.

Date of admission to hospital. 26.11.35.

Age. 46.

Sex. M.

Social state. Married.

Occupation. Male Nurse.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms.

Years. 5 Months.

Physical signs, respiratory system.

Present. ~~Absent.~~

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 80/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 130/72 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse ~~in Th. intercostal space. inches~~
not definable. (~~from midsternal line.~~)
2. Cardiac sounds. ~~pure.~~ impure.
3. Character of murmur. Mitral systolic: not conducted.

Average temperature. (modal) 99° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	+

Transverse diameter of heart:- $4\frac{1}{2}$ inches.Internal diameter of thorax:- $11\frac{1}{2}$ inches.

Cardiothoracic index. 39.13

Asthenic.	Sthenic.	Hypersthenic.
+		

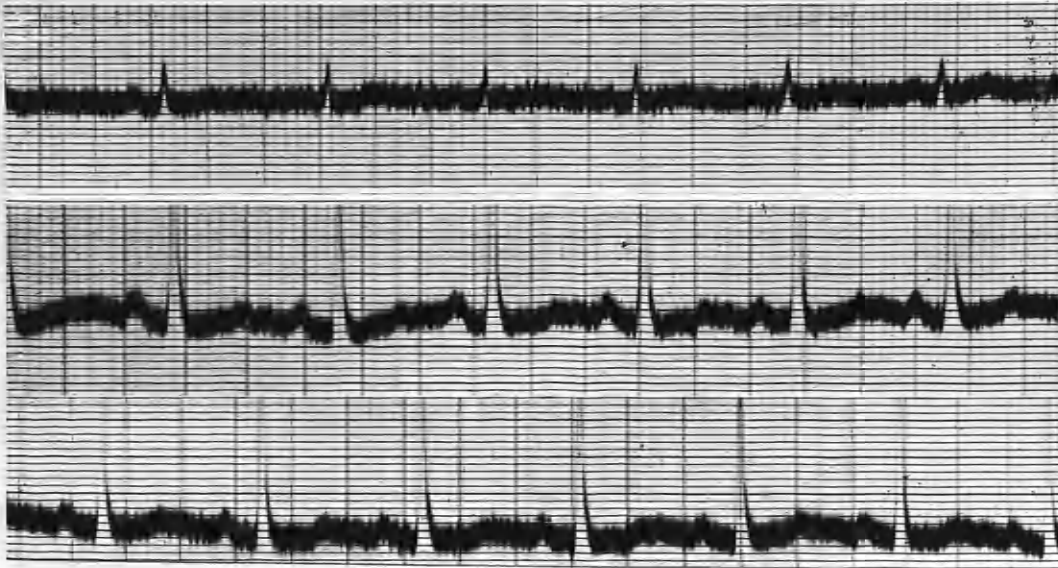
Electrocardiogram.

~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	+	-	-	-	-	-	-	-

Remarks. An acute case in which the electrocardiogram shows low voltage in Lead I. A systolic murmur is present at the mitral area.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. MS/21/26.
 Date of admission to hospital. 26.11.35.
 Age. 32.
 Sex. F.
 Social state. Married.
 Occupation. Housework.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 5 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 116/minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 124/90 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in IV.Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 97.6° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- 8 $\frac{3}{4}$ inches.
 Cardiothoracic index. 45.71

Asthenic.	Sthenic.	Hypersthenic.
	+	

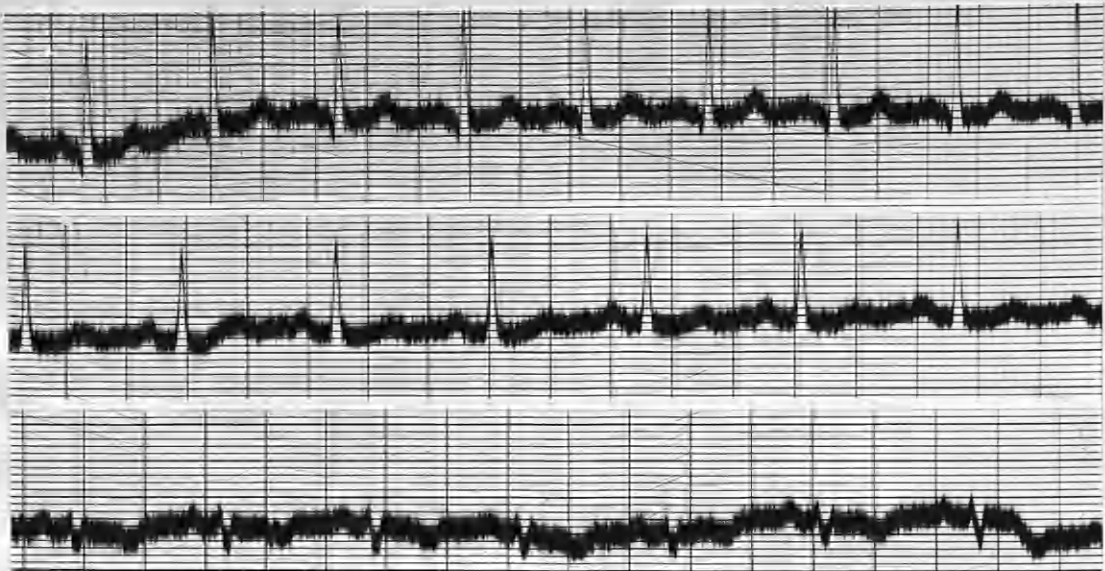
Electrocardiogram. Normal. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	+	-	-	-	-	+

Remarks. A case of some years' standing. There is tachycardia. The electrocardiogram shows low voltage in Lead III.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

101.



CASE MS/21/26.

Name. CB/22/27.

Date of admission to hospital. 11.12.35.

Age. 34.

Sex. M.

Social state. Single.

Occupation. Labourer.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms.

Years. 8 Months.

Physical signs, respiratory system.

Present. ~~Absent.~~

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 80/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 116/68 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $4\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 99° Afebrile. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- $4\frac{1}{4}$ inches.Internal diameter of thorax:- $10\frac{1}{2}$ inches.

Cardiothoracic index. 40.48

Asthenic.	Sthenic.	Hypersthenic.
	+	

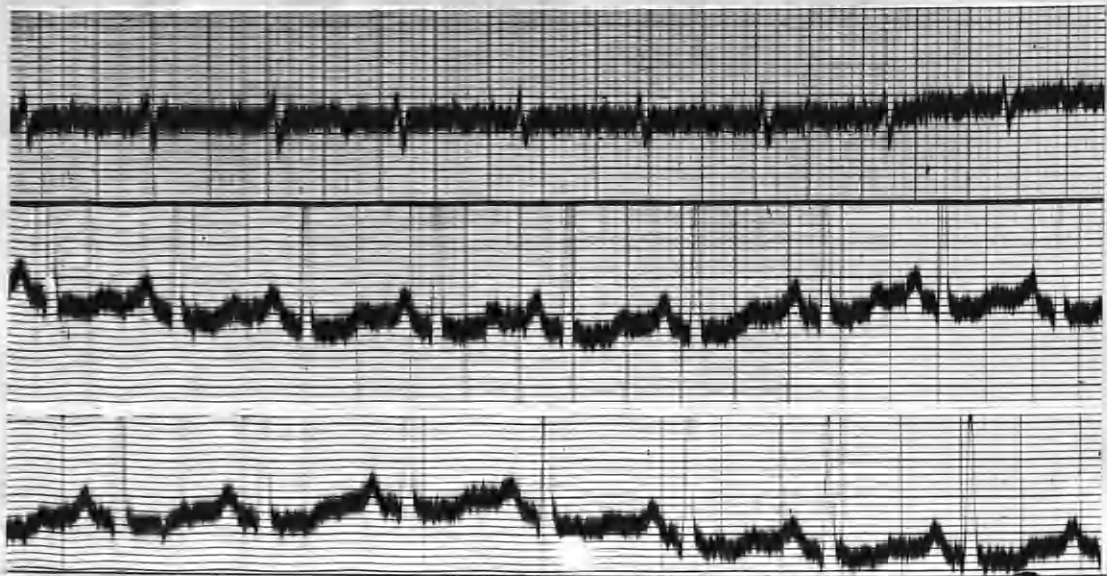
Electrocardiogram.

Normal. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	+	-	-	-	-	-	-	-

Remarks. The electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. RK/23/28.
 Date of admission to hospital. 13.12.35.
 Age. 28.
 Sex. M.
 Social state. Single.
 Occupation. Labourer.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. Many Years. Months.
 Physical signs, respiratory system. Present. ~~Absent.~~
 Tubercle bacilli in sputum. ~~Present.~~ Absent.

Average pulse rate. (modal) 92/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 120/84 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $2\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. ? pure. ? impure.
3. Character of murmur.

Average temperature. (modal) 98° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 40.0

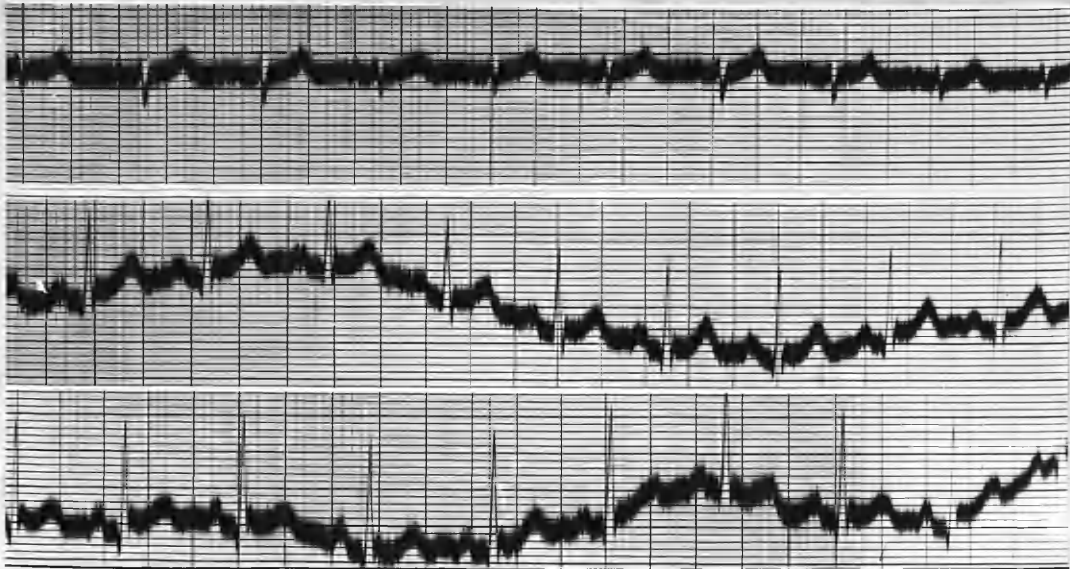
Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. ~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25Seconds	+	-	-	-	-	-	-	-

Remarks. A case of many years' standing. There is mild tachycardia. The electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. LM/24/3.
 Date of admission to hospital. 4.1.36.
 Age. 19.
 Sex. M.
 Social state. Single.
 Occupation. Salesman.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 1 Months.
 Physical signs, respiratory system. Present. Absent. Doubtful.
 Tubercle bacilli in sputum. Present. Absent.

Average pulse rate. (modal) 84/minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 130/70 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in ? Th. intercostal space, 3 inches
(from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 98° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- 11½ inches.
 Cardiothoracic index. 34.78

Asthenic.	Sthenic.	Hypersthenic.
+		

Electrocardiogram.

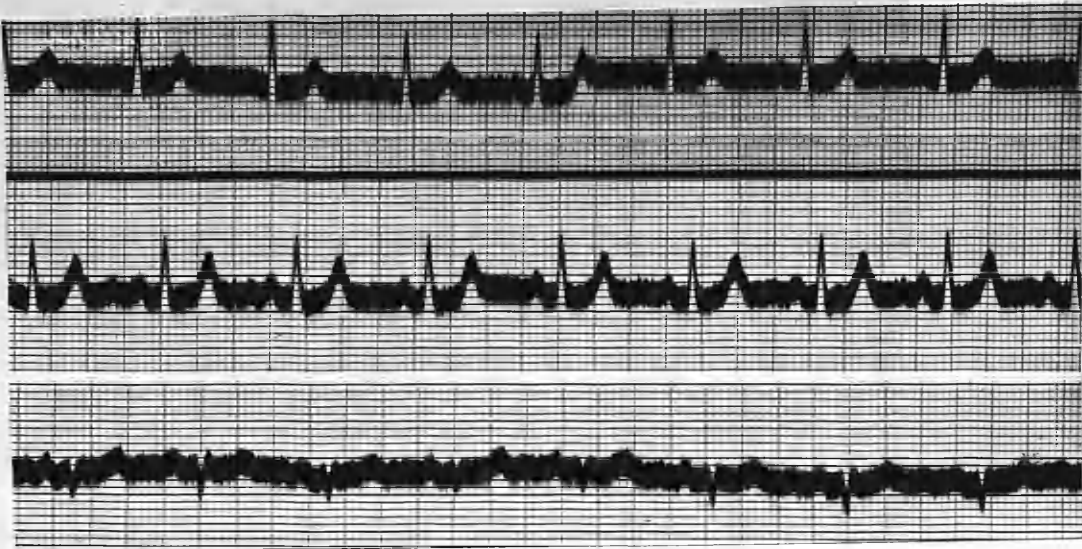
Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
13/100 Seconds	-	-	-	-	-	-	-	-

Remarks. An acute case with no apparent cardiovascular involvement; the heart is asthenic.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

107.



CASE LM/24/3.

Name. AE/25/7.
 Date of admission to hospital. 5.1.36.
 Age. 40.
 Sex. F.
 Social state. Single.
 Occupation. Secretary.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 2 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent.~~
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 100/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 120/80 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, inches
(from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur. -

Average temperature. (modal) 100.4° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- $3\frac{3}{4}$ inches.
 Internal diameter of thorax:- $10\frac{1}{4}$ inches.
 Cardiothoracic index. 36.59

Asthenic.	Sthenic.	Hypersthenic.
+		

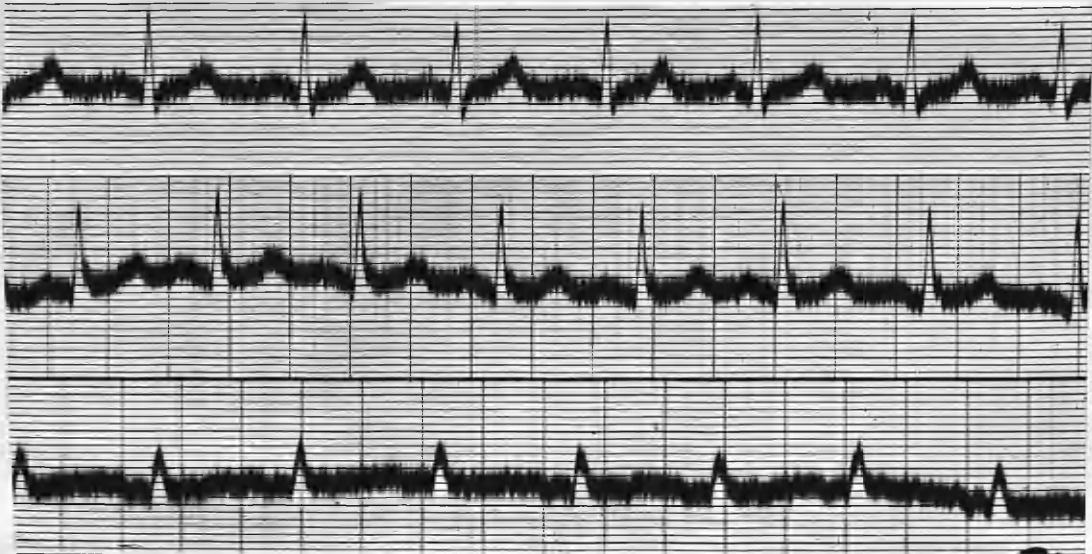
Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	-

Remarks. A case of two years' standing showing mild tachycardia, and an asthenic heart.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE AE/25/7.

Name. EW/26/1.
 Date of admission to hospital. 5.1.36.
 Age. 44.
 Sex. F.
 Social state. Married.
 Occupation. Housewife.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. About 10 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 84/minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 130/82 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in V. Th. intercostal space, $3\frac{1}{4}$ inches
 (from midsternal line).
2. Cardiac sounds. ~~pure~~. impure.
3. Character of murmur. Mitral systolic.

Average temperature. (modal) 99° ~~Afebrile~~. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	
Lower.	+	

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- 9 inches.
 Cardiothoracic index. 44.44

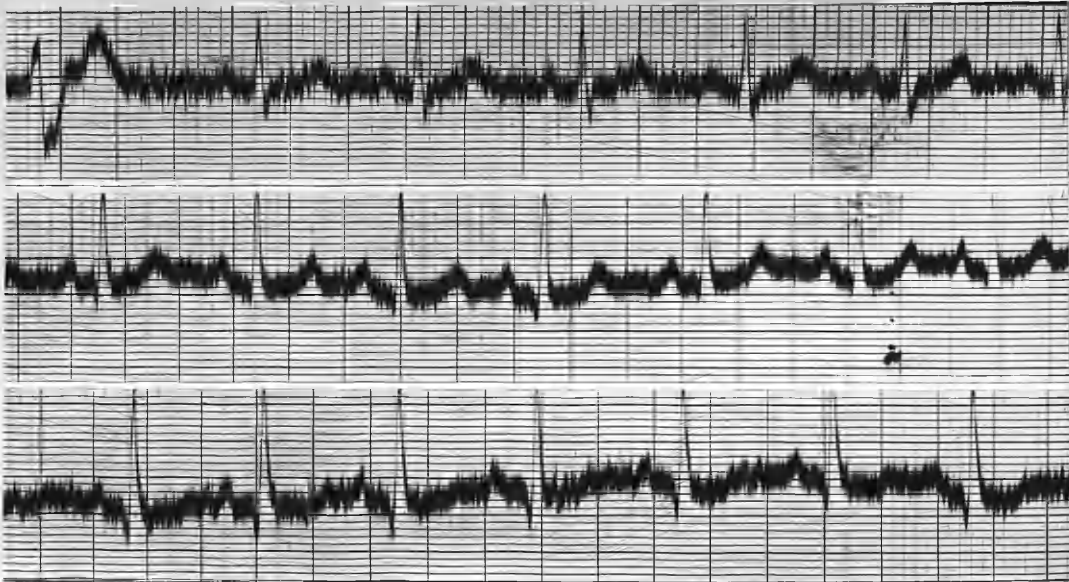
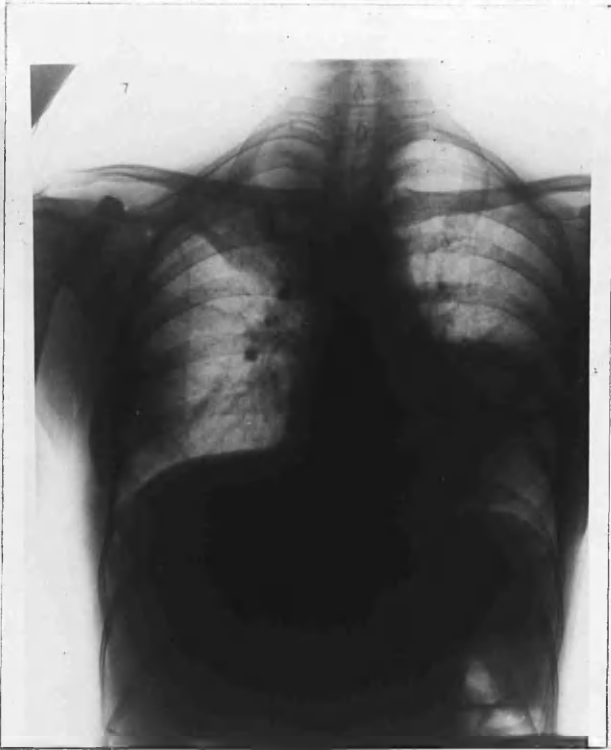
Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
9/50 Seconds	-	-	-	-	-	-	-	-

Remarks. A case of some years' standing, showing no serious cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. AE/27/42.
 Date of admission to hospital. 6.1.36.
 Age. 30.
 Sex. M.
 Social state. Married.
 Occupation. Decorator.

Type of work.	
Light.	Heavy.
-	+

Duration of Symptoms. Years. 3 Months.
 Physical signs, respiratory system. Present. Absent.
 Tubercle bacilli in sputum. Present. Absent.

Average pulse rate. (modal) 82/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 124/76 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 3 inches
(from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98.4° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	-	-

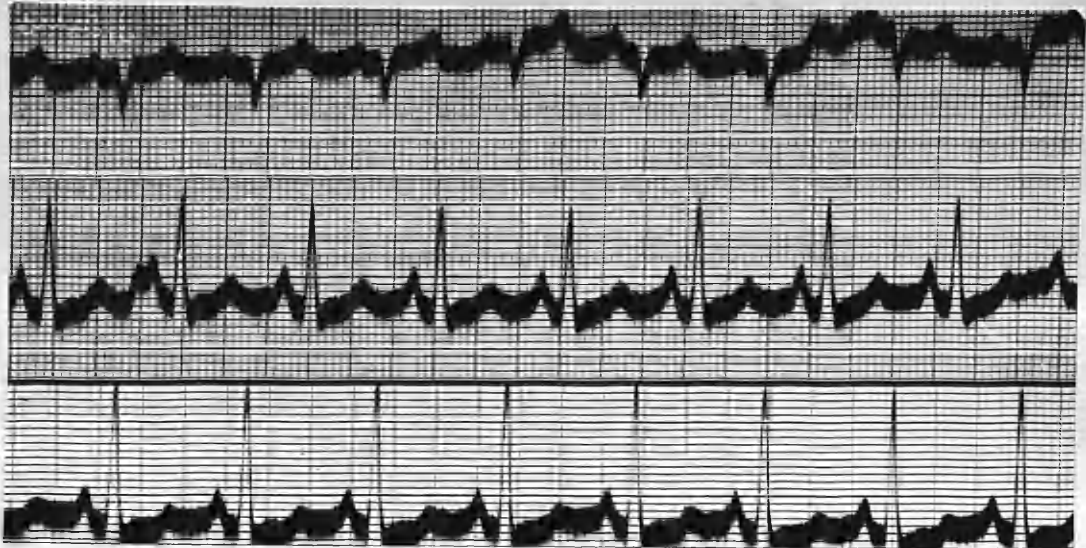
Transverse diameter of heart:- $4\frac{1}{2}$ inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 45

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. ~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25Seconds	-	-	-	-	+	-	-	-

Remarks. An acute case with fairly extensive pulmonary involvement. The electrocardiogram shows the cardiac axis deviated to the right.
 Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. AB/28/38.
 Date of admission to hospital. 7.1.36.
 Age. 56.
 Sex. M.
 Social state. Married.
 Occupation. Motor Fitter.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. Years. 2 Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 70/minute. regular. irregular.
 Average blood pressure. (modal) 120/80 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 97.6° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- 5 inches.
 Internal diameter of thorax:- 10 $\frac{3}{4}$ inches.
 Cardiothoracic index. 48.31

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram.

~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	-	+	-	-	-	-

Remarks. A patient in the fifth decade with a recent tuberculo-
 sis infection. The cardiac axis is deviated to
 the left.

Reproductions of X Ray plates, and electrocardiogram are given on
 the following page.



Name. HB/29/5.

Date of admission to hospital. 7.1.36.

Age. 24.

Sex. M.

Social state. Single.

Occupation. Telephone Operator.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms.

Years. 2 Months.

Physical signs, respiratory system.

Present. ~~Absent.~~

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 64/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 126/80 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 97.6° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- $4\frac{3}{4}$ inches.Internal diameter of thorax:- $10\frac{1}{2}$ inches.

Cardiothoracic index. 45.24

Asthenic.	Sthenic.	Hypersthenic.
	+	

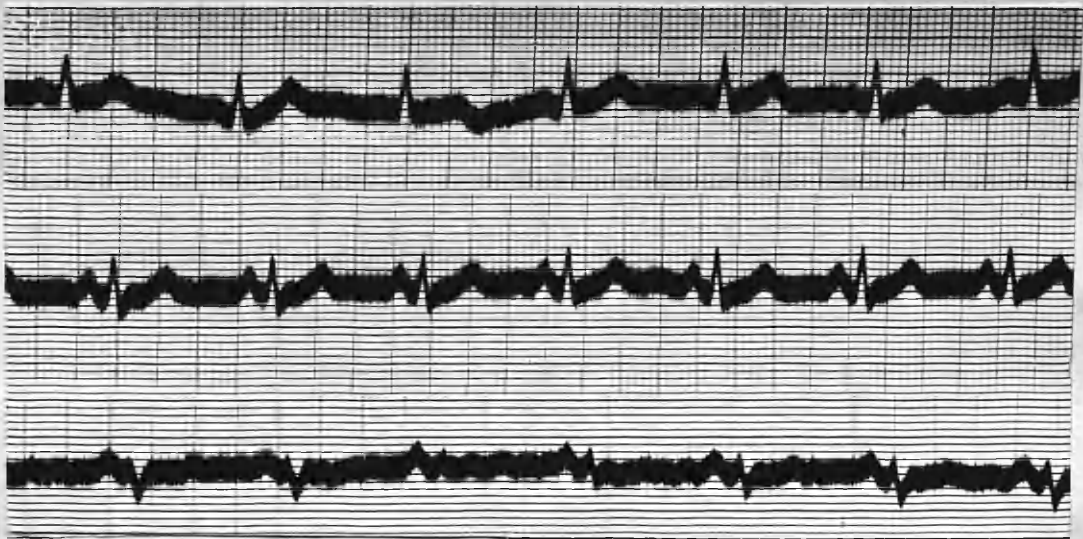
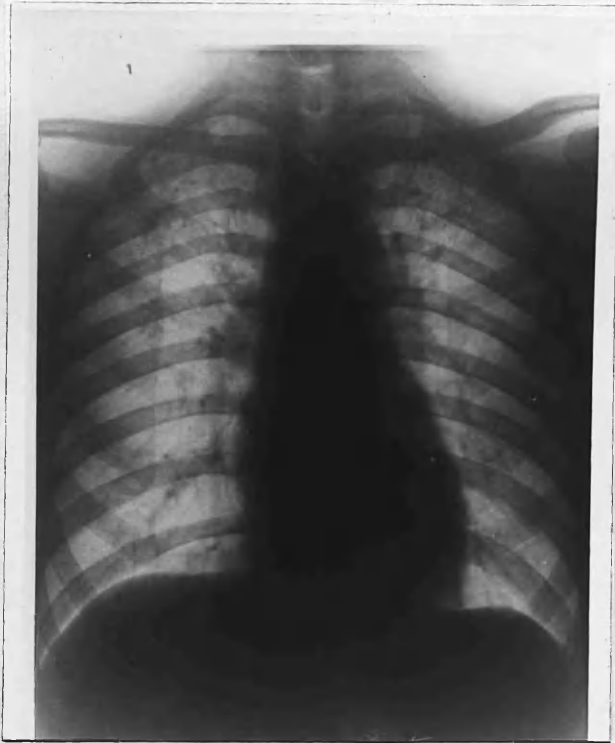
Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	-	-	-	-	-	-

Remarks. A fairly acute case without cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. EJ/30/39.
 Date of admission to hospital. 7.1.36.
 Age. 20.
 Sex. F.
 Social state. Single.
 Occupation. At home.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 3 Months.
 Physical signs, respiratory system. Present. ~~Absent.~~
 Tubercle bacilli in sputum. ~~Present.~~ Absent.

Average pulse rate. (modal) 72/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 120/70 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98° Afebrile. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.		+
Lower.		

Transverse diameter of heart:- $4\frac{3}{4}$ inches.
 Internal diameter of thorax:- $9\frac{7}{8}$ inches.
 Cardiothoracic index. 48.10

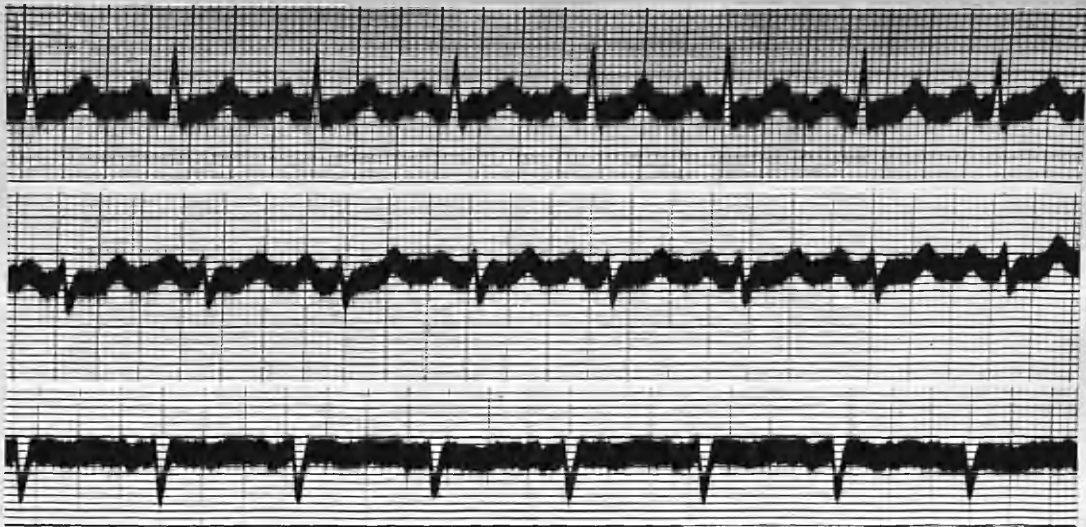
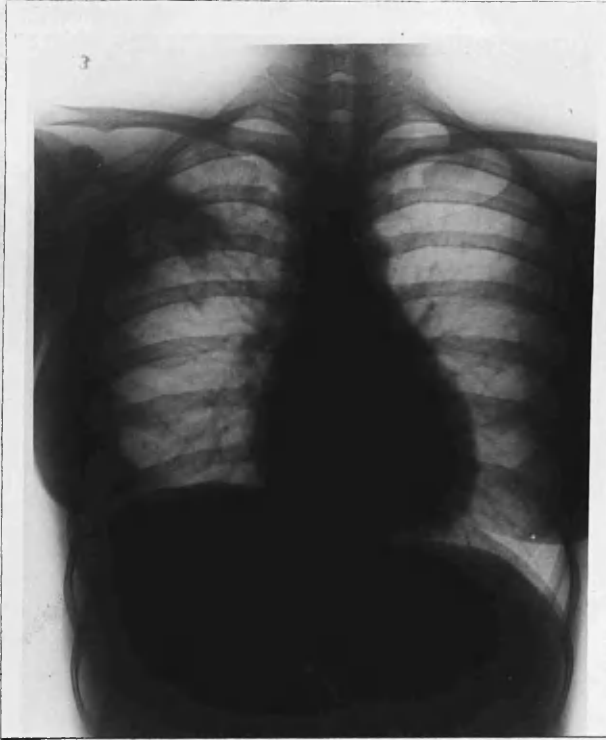
Asthenic..	Sthenic..	Hypersthenic..
	+	

Electrocardiogram. ~~Normal..~~ Abnormal..

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left..	Right..	I..	II..	III..
3/25 Seconds	-	-	-	+	-	-	-	-

Remarks. A young patient with a recent infection. The electrocardiogram shows the cardiac axis deviated to the left.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. EW/31/25.
 Date of admission to hospital. 7.1.36.
 Age. 53.
 Sex. M.
 Social state. Married.
 Occupation. Secretary.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 2 Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 80/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 110/74 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 3 inches
(from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 97.4° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.		+
Lower.		

Transverse diameter of heart:- 3½ inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 35.0

Asthenic.	Sthenic.	Hypersthenic.
+	-	-

Electrocardiogram.

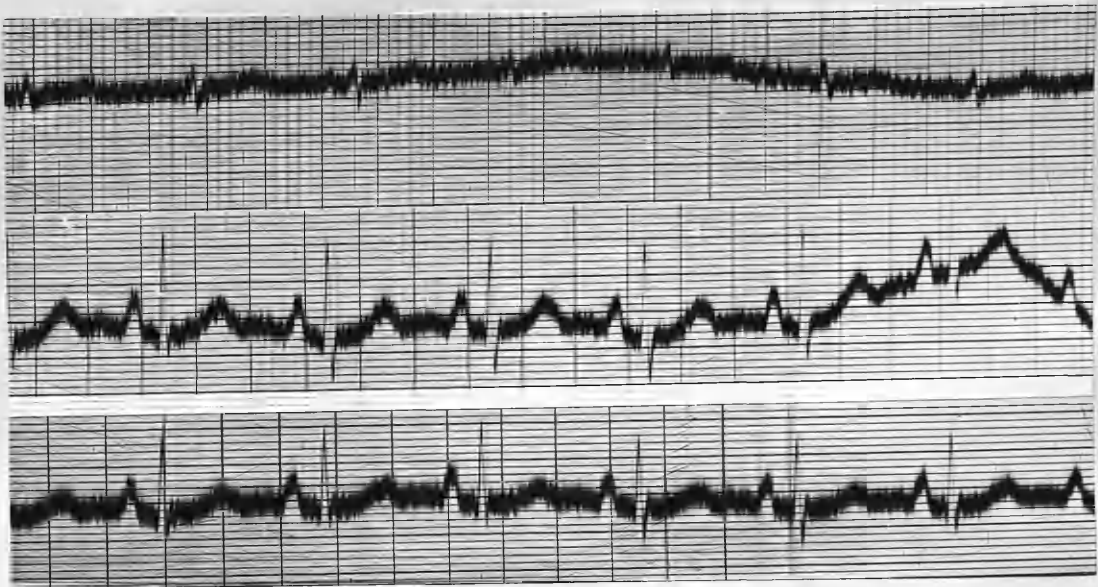
~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	+	-	-	-	-	-	-	-

Remarks. The heart is asthenic and the electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

120a.



CASE EW/31/25.

Name. CI/32/6.
 Date of admission to hospital. 10.1.36.
 Age. 18.
 Sex. F.
 Social state. Single.
 Occupation. Typist.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 2 Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. ~~Present.~~ Absent.

Average pulse rate. (modal) 80/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 120/80 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98.4° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.		+
Lower.		

Transverse diameter of heart:- $3\frac{1}{4}$ inches.
 Internal diameter of thorax:- $9\frac{1}{4}$ inches.
 Cardiothoracic index. 35.13

Asthenic.	Sthenic.	Hypersthenic.
+		

Electrocardiogram.

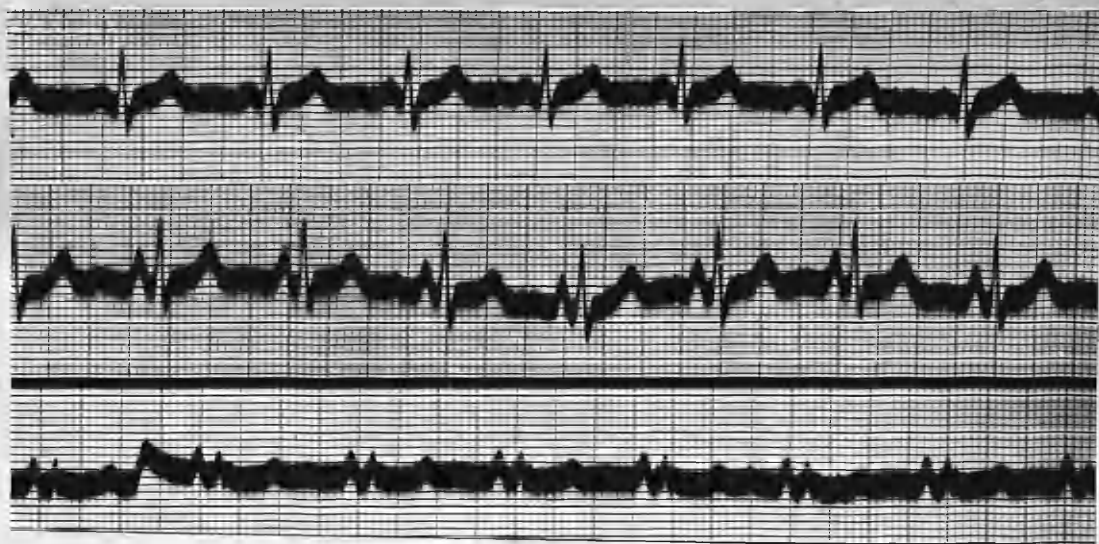
Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
7/50 Seconds	-	-	-	-	-	-	-	-

Remarks. A recent case with no apparent cardiovascular involvement; the heart is asthenic.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

121a.



CASE CI/32/6.

Name. EC/33/2.

Date of admission to hospital. 16.1.36.

Age. 32.

Sex. M.

Social state. Married.

Occupation. Labourer.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms.

Years. < 1 Months.

Physical signs, respiratory system.

Present. ~~Absent.~~

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 70/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 114/76 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in ? Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- 5 inches.

Internal diameter of thorax:- 10 $\frac{3}{4}$ inches.

Cardiothoracic index. 46.51

Asthenic.	Sthenic.	Hypersthenic.
	+	

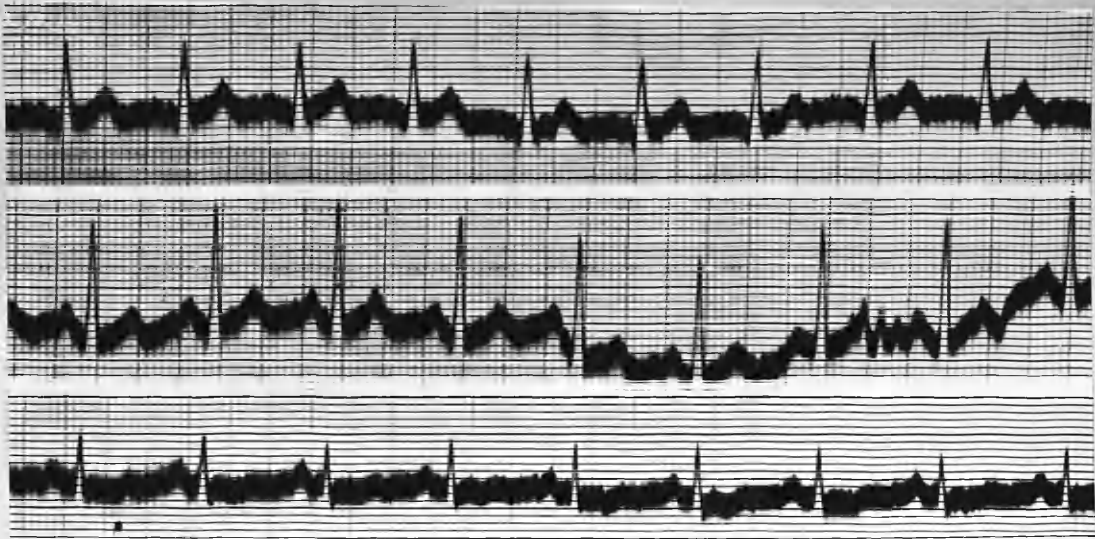
Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	-	-	-	-	-	-

Remarks. No apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. RT/34/4.

Date of admission to hospital. 16.1.36.

Age. 19.

Sex. M.

Social state. Single.

Occupation. Electrical Engineer.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms.

2 Years. Months.

Physical signs, respiratory system.

~~Present.~~ Absent. Doubtful.

Tubercle bacilli in sputum.

~~Present.~~ Absent.Average pulse rate. (modal) 60 /minute. regular. ~~irregular.~~

Average blood pressure. (modal) 128/72 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in ? Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- $3\frac{3}{4}$ inches.Internal diameter of thorax:- $10\frac{1}{2}$ inches.

Cardiothoracic index. 35.71

Asthenic.	Sthenic.	Hypersthenic.
+		

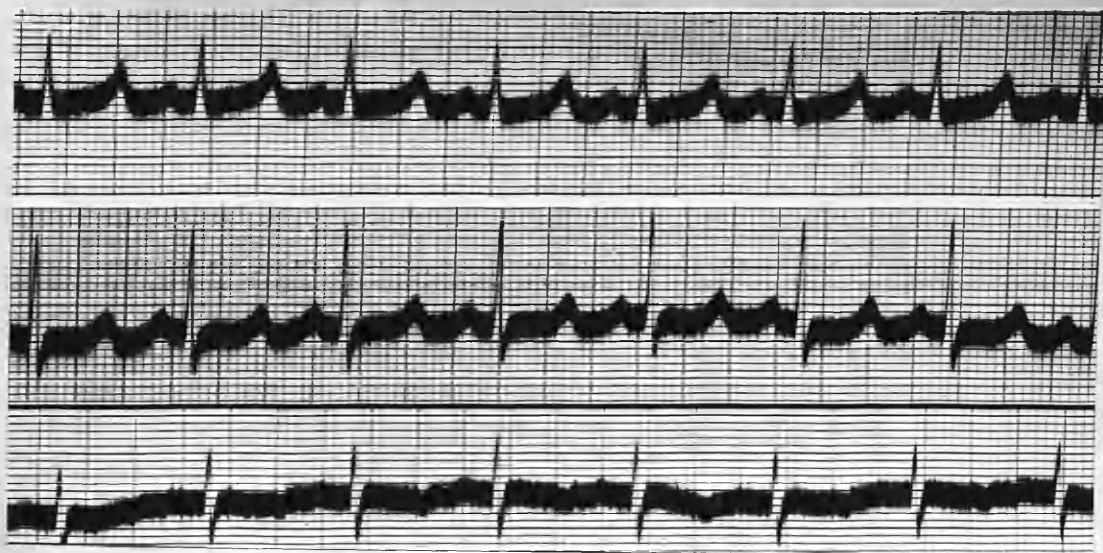
Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	-	-	-	-	-	-

Remarks. A case of asthenic heart, without organic change.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE RT/34/4.

Name. DF/35/8.

Date of admission to hospital. 18.1.36.

Age. 24.

Sex. F.

Social state. Single.

Occupation. Cashier.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 8 Years. Months.

Physical signs, respiratory system. Present. ~~Absent~~.Tubercle bacilli in sputum. Present. ~~Absent~~.Average pulse rate. (modal) 88/minute. regular. ~~irregular~~.

Average blood pressure. (modal) 120/80 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur. -

Average temperature. (modal) 99° ~~Afebrile~~. Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.		+
Lower.		+

Transverse diameter of heart:- $3\frac{3}{4}$ inches.

Internal diameter of thorax:- 9 inches.

Cardiothoracic index. 41.67

Asthenic.	Sthenic.	Hypersthenic.
	+	

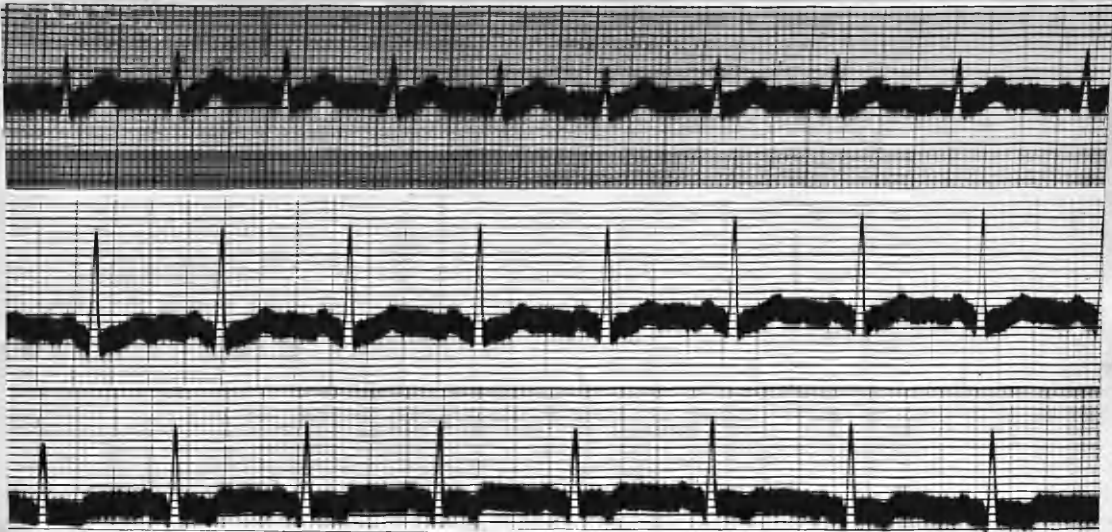
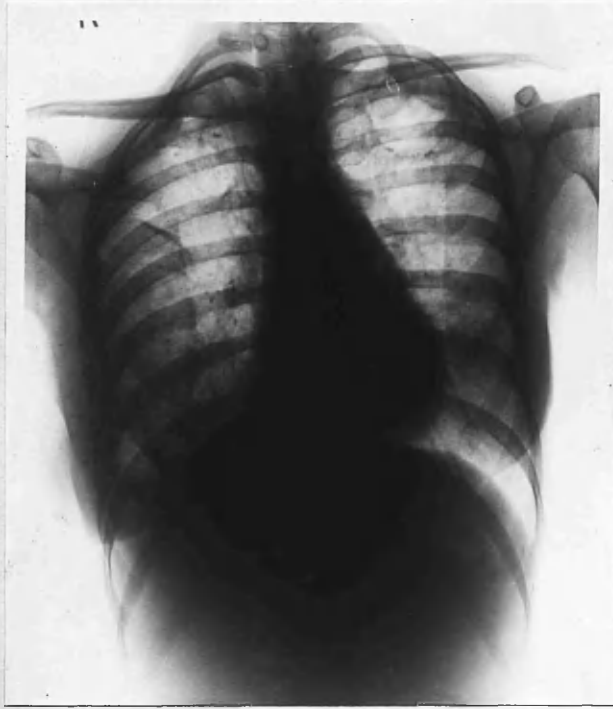
Electrocardiogram.

Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25Seconds	-	-	-	-	-	-	-	-

Remarks. A long standing case with no apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. FD/36/12.

Date of admission to hospital. 19.1.36.

Age. 20.

Sex. M.

Social state. Single.

Occupation. Booking Clerk.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 1 Years. 3 Months.

Physical signs, respiratory system. Present. ~~Absent~~.Tubercle bacilli in sputum. ~~Present~~. Absent.Average pulse rate. (modal) 102~~7~~ minute. regular. ~~irregular~~.

Average blood pressure. (modal) 120/70 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 4 $\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 98.4° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.	+	+
Lower.		

Transverse diameter of heart:- 5 inches.

Internal diameter of thorax:- 10 $\frac{3}{4}$ inches.

Cardiothoracic index. 41.51

Asthenic.	Sthenic.	Hypersthenic.
	+	

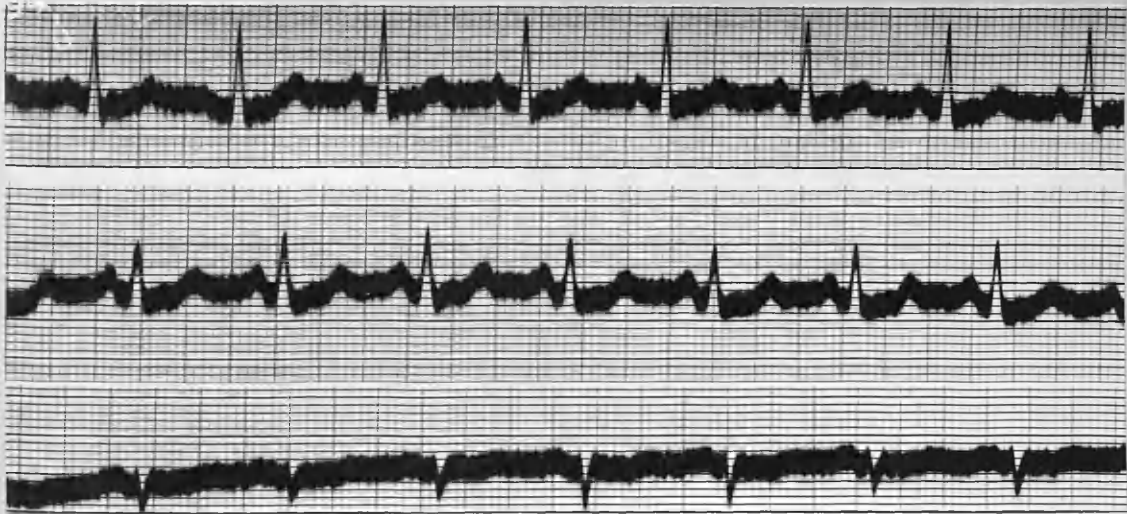
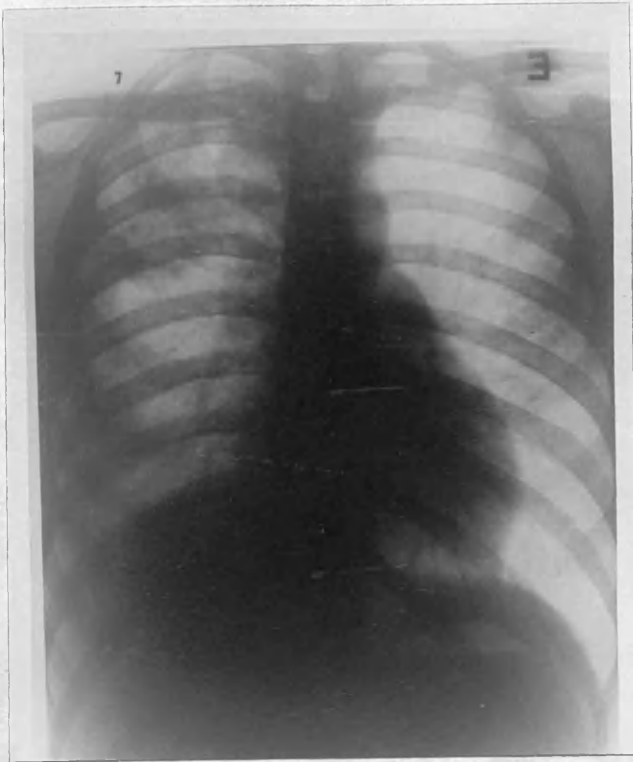
Electrocardiogram.

Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	-

Remarks. Showing persistent tachycardia, but no other apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. HL/37/10.

Date of admission to hospital. 19.1.36.

Age. 17.

Sex. M.

Social state. Single.

Occupation. Unemployed.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms.

2 Years. Months.

Physical signs, respiratory system.

Present. ~~Absent.~~

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 88/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 130/76 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98.2 Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		+

Transverse diameter of heart:- $4\frac{1}{2}$ inches.

Internal diameter of thorax:- 10 inches.

Cardiothoracic index. 45.0

Asthenic.	Sthenic.	Hypersthenic.
	+	

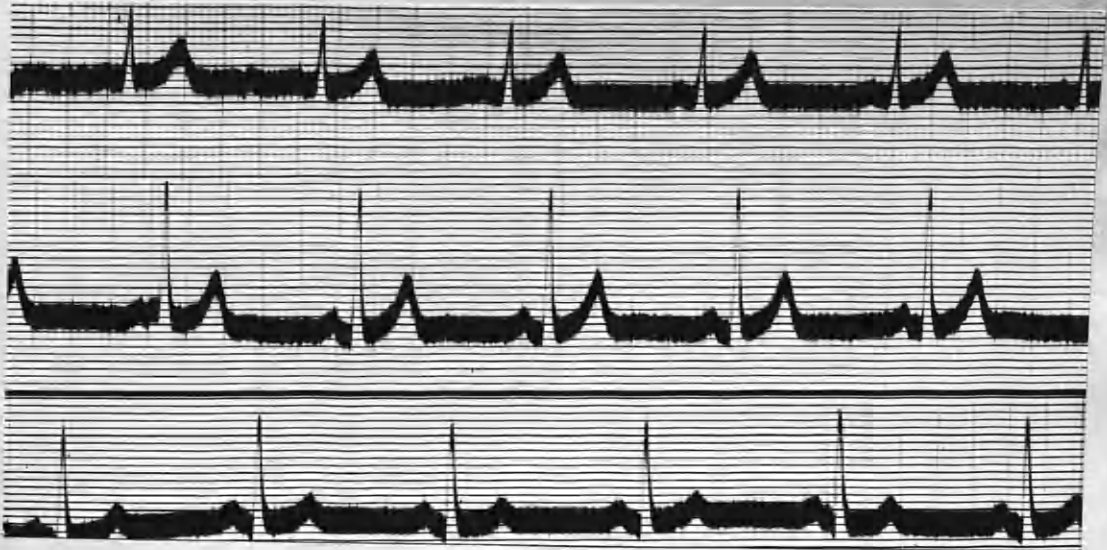
Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	-

Remarks. Beyond mild tachycardia, no apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. WH/38/11.
 Date of admission to hospital. 23.1.36.
 Age. 32.
 Sex. M.
 Social state. Married.
 Occupation. Paint dipper.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 2 Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 60/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 130/70 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~Impure.~~
3. Character of murmur. -

Average temperature. (modal) 97.4° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	

Transverse diameter of heart:- 5 inches.
 Internal diameter of thorax:- $11\frac{1}{2}$ inches.
 Cardiothoracic index. 43.48

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	-	-	-	-	-	-	-	+

Remarks. A recent case with no apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. HP/39/9.
 Date of admission to hospital. 23.1.36.
 Age. 43.
 Sex. M.
 Social state. Single.
 Occupation. Porter.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. Years. 4 Months.
 Physical signs, respiratory system. Present. Absent. Doubtful.
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 80 /minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 108/70 millimetres of mercury.
 Physical signs, cardiovascular system:-
 1. Apex impulse in Th. intercostal space, 2½ inches
 (from midsternal line).
 2. Cardiac sounds. pure. ~~impure.~~
 3. Character of murmur.

Average temperature. (modal) 97° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.	+	+
Lower.		

Transverse diameter of heart:- 4½ inches.
 Internal diameter of thorax:- 11¼ inches.
 Cardiothoracic index. 40

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	-	-	-	-	-	-

Remarks. There is a mild degree of hypotension but no other organic cardiovascular change.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE HP/39/9.

Name. EJ/40/24.

Date of admission to hospital. 26.1.36.

Age. 47.

Sex. F.

Social state. Widow.

Occupation. Housework.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms.

Years. 4 Months.

Physical signs, respiratory system.

Present. ~~Absent.~~

Tubercle bacilli in sputum.

Present. ~~Absent.~~Average pulse rate. (modal) 90/minute. regular. ~~irregular.~~

Average blood pressure. (modal) 110/70 millimetres of mercury.

Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 3 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 99.2° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- 3 inches.

Internal diameter of thorax:- 9.5 inches.

Cardiothoracic index. 31.57

Asthenic.	Sthenic.	Hypersthenic.
+		

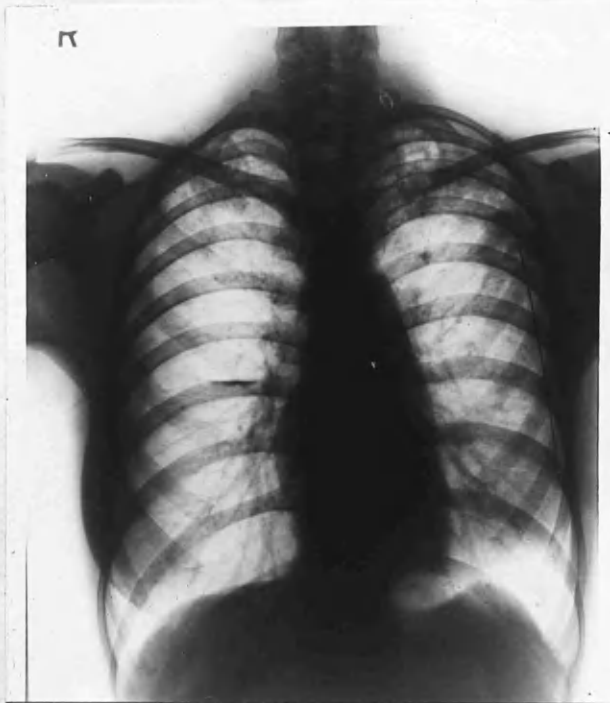
Electrocardiogram.

~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	+	-	-	-	-	-	-	-

Remarks. An acute case with mild tachycardic. The heart is asthenic. The electrocardiogram shows low voltage in Lead I. *Arthythmia*

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. EP/41/14.
 Date of admission to hospital. 26.1.36.
 Age. 20.
 Sex. M.
 Social state. Single.
 Occupation. Electrical Engineer.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 5 Years. Months.
 Physical signs, respiratory system. ~~Present.~~ Absent.
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 82/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 112/74 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $2\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 99.2° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.		+
Lower.		+

Transverse diameter of heart:- 5 inches.
 Internal diameter of thorax:- $10\frac{1}{2}$ inches.
 Cardiothoracic index. 47.62

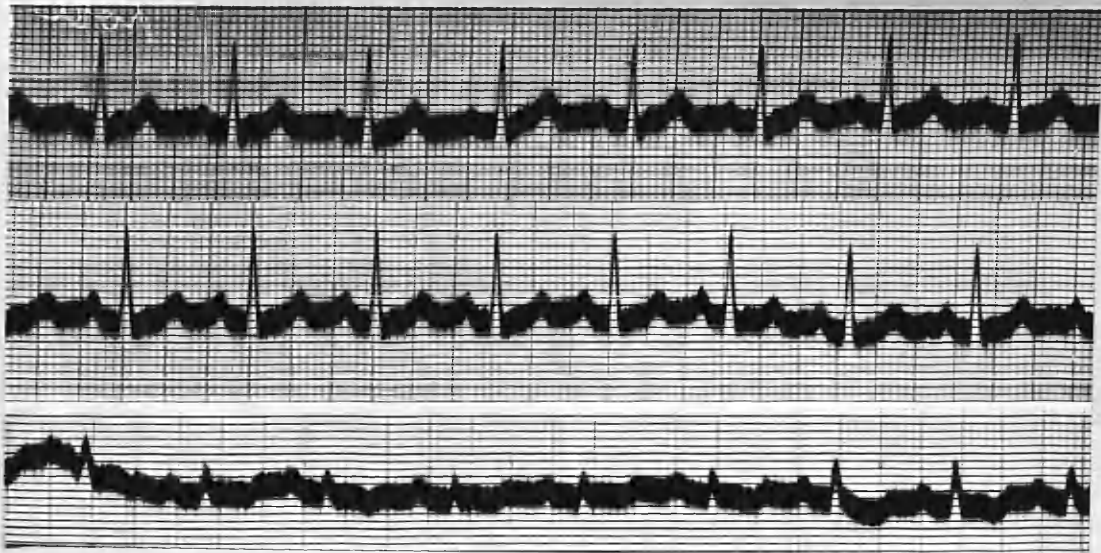
Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram. Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
7/50 Seconds	-	-	-	-	-	-	-	-

Remarks. There is no apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



CASE EP/41/14.

Name. DG/42/23.
 Date of admission to hospital. 30.1.36.
 Age. 24.
 Sex. M.
 Social state. Married.
 Occupation. Insurance Clerk.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. Years. 9 Months.
 Physical signs, respiratory system. Present. ~~Absent.~~
 Tubercle bacilli in sputum. Present. ~~Absent.~~

Average pulse rate. (modal) 100/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 126/80 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $2\frac{3}{4}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 97.6° Afebrile. ~~Febrile.~~

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.		

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- $10\frac{1}{4}$ inches.
 Cardiothoracic index. 39.02

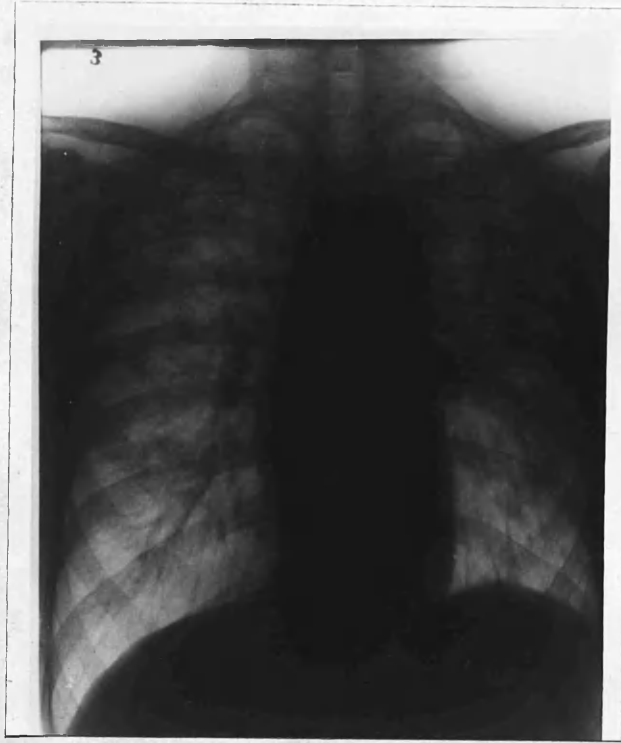
Asthenic.	Sthenic.	Hypersthenic.
+		

Electrocardiogram. ~~Normal.~~ Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	+	-	-	-	-	-	-	X

Remarks. An acute case, with tachycardia. The heart is asthenic
 The electrocardiogram shows low voltage in Lead I.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. WW/43/15.
 Date of admission to hospital. 15.2.36.
 Age. 30.
 Sex. M.
 Social state. Single.
 Occupation. Theatre attendant.

Type of work.	
Light.	Heavy.
+	

Duration of Symptoms. 2 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent.~~
 Tubercle bacilli in sputum. ~~Present.~~ Absent.

Average pulse rate. (modal) 84/minute. regular. ~~irregular.~~
 Average blood pressure. (modal) 120/70 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, $3\frac{1}{2}$ inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure.~~
3. Character of murmur.

Average temperature. (modal) 98.8° ~~Afebrile.~~ Febrile.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	+

Transverse diameter of heart:- 4 inches.
 Internal diameter of thorax:- $11\frac{1}{4}$ inches.
 Cardiothoracic index. 35.56

Asthenic.	Sthenic.	Hypersthenic.
+		

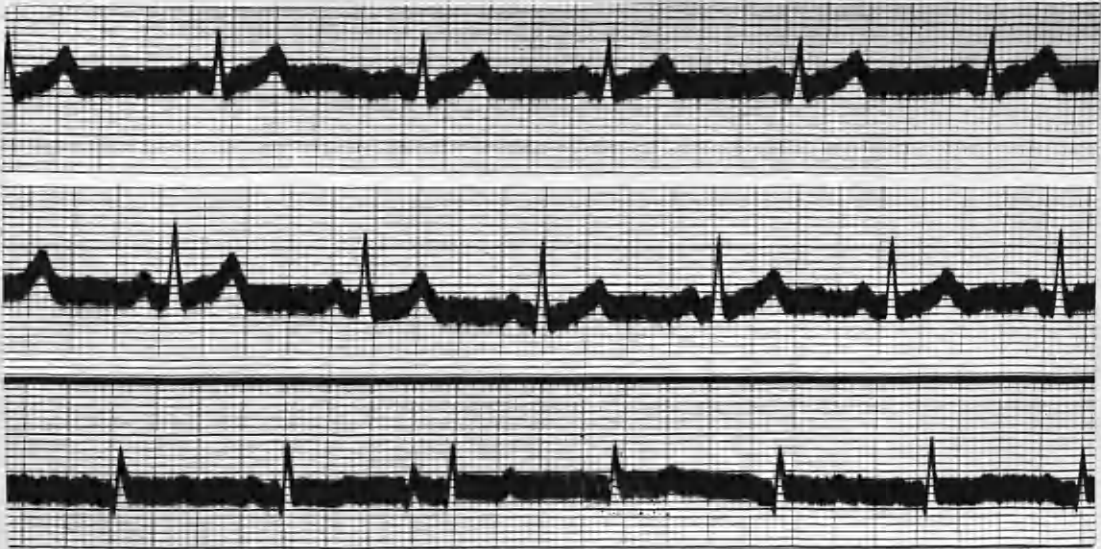
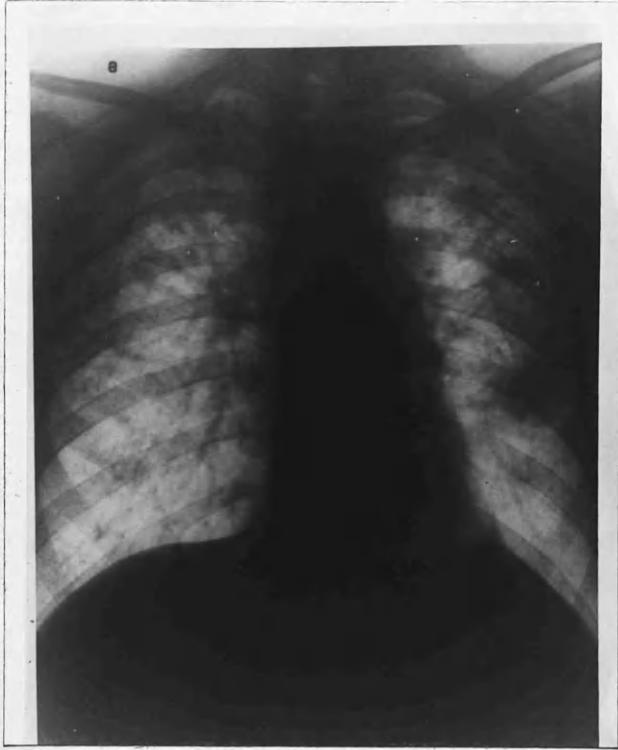
Electrocardiogram.

Normal. ~~Abnormal.~~

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
9/50 Seconds	-	-	-	-	-	-	-	-

Remarks. The heart is asthenic, but there is no apparent organic change.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. TA/44/43.
 Date of admission to hospital. 16.2.36.
 Age. 56.
 Sex. M.
 Social state. Married.
 Occupation. Composer.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. Years. 8 Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. ~~Absent~~.

Average pulse rate. (modal) 78 /minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 114/100 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 4 inches (from midsternal line).
2. Cardiac sounds. pure. ~~impure~~. Aortic 2nd sound
3. Character of murmur. much accentuated.

Average temperature. (modal) 97.8° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.	+	+
Middle.	+	+
Lower.	+	

Transverse diameter of heart:- 3 $\frac{7}{8}$ inches.
 Internal diameter of thorax:- 10 inches.
 Cardiothoracic index. 38.75

Asthenic.	Sthenic.	Hypersthenic.
+		

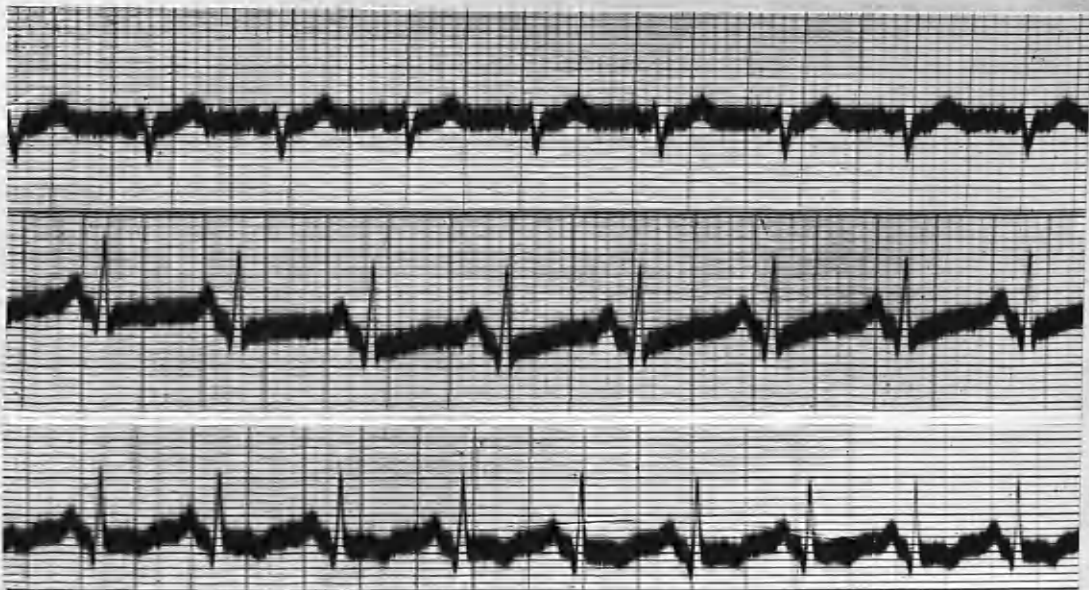
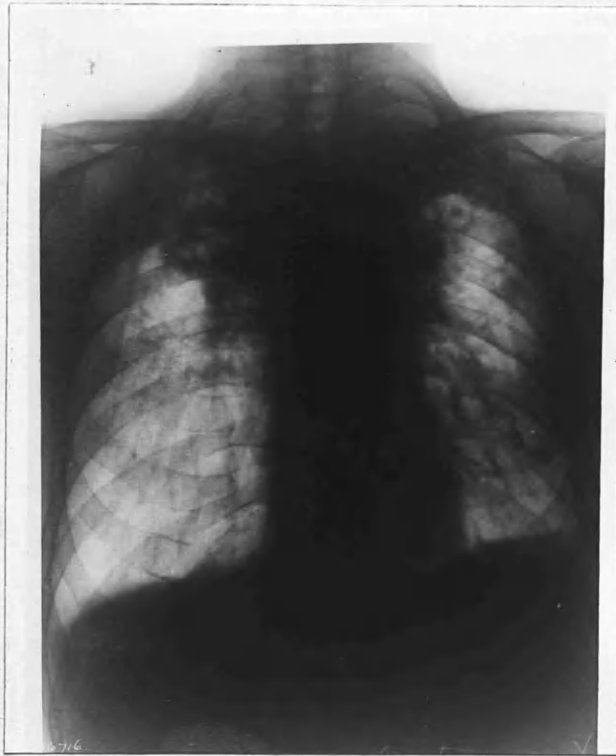
Electrocardiogram.

~~Normal~~. Abnormal.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
3/25 Seconds	x				+			+

Remarks. A recent case with extensive pulmonary involvement.
 The electrocardiogram shows the cardiac axis deviated to the right.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.



Name. HM/45/13.
 Date of admission to hospital. 16.2.36.
 Age. 29.
 Sex. M.
 Social state. Married.
 Occupation. Engineer.

Type of work.	
Light.	Heavy.
	+

Duration of Symptoms. 2 Years. Months.
 Physical signs, respiratory system. Present. ~~Absent~~.
 Tubercle bacilli in sputum. Present. Absent.

Average pulse rate. (modal) 72 /minute. regular. ~~irregular~~.
 Average blood pressure. (modal) 102/70 millimetres of mercury.
 Physical signs, cardiovascular system:-

1. Apex impulse in Th. intercostal space, 3 inches
(from midsternal line).
2. Cardiac sounds. pure. ~~impure~~.
3. Character of murmur.

Average temperature. (modal) 98° Afebrile. ~~Febrile~~.

X Ray examination of chest. Zones affected:-

	Left.	Right.
Upper.		+
Middle.	+	
Lower.		+

Transverse diameter of heart:- 5 inches.
 Internal diameter of thorax:- 11 inches.
 Cardiothoracic index. 45.45

Asthenic.	Sthenic.	Hypersthenic.
	+	

Electrocardiogram.

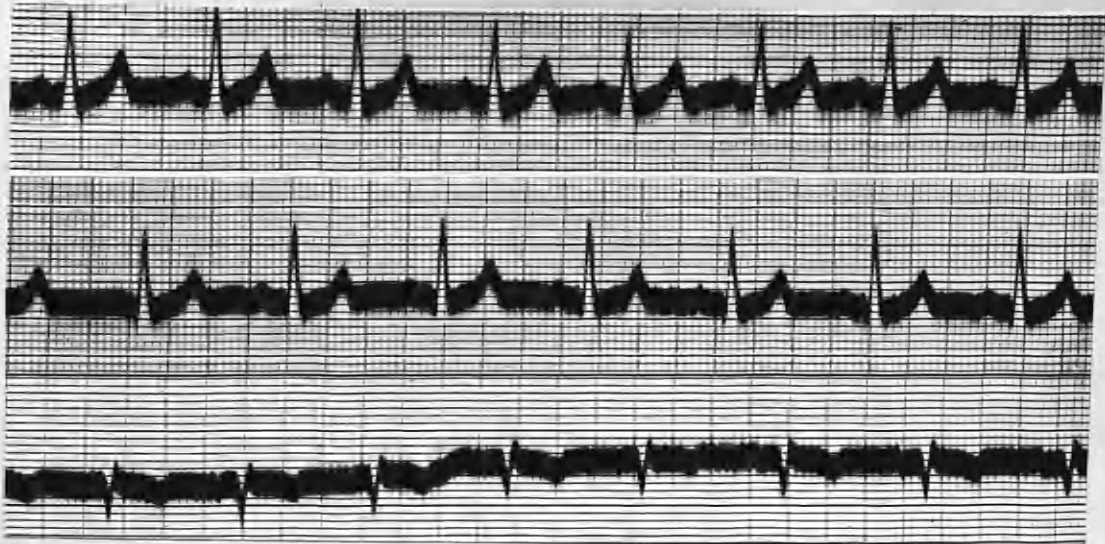
Normal. ~~Abnormal~~.

PR interval	Low potential			Axis deviation		Inverted "T"		
	I.	II.	III.	Left.	Right.	I.	II.	III.
4/25 Seconds	-	-	-	-	-	-	-	+

Remarks. There is a mild degree of hypotension but no other apparent cardiovascular involvement.

Reproductions of X Ray plates, and electrocardiogram are given on the following page.

147.



CASE HM/45/13.



"A case of Silicosis complicated by pulmonary tuberculosis showing the appearance of "shaggy heart."

(Included by the courtesy of the Home Office).

CASE T/46/46.



"A case of Asbestosis complicated by pulmonary tuberculosis showing the appearance of "shaggy heart."

(Included by the courtesy of the Home Office).

CLASSIFICATION AND ANALYSIS.

CLASSIFICATION AND ANALYSIS.

The present series of cases numbered 45, of which 29, (64.4%) were males, and 16, (35.6%) were females. The average age was 30.4 years, and the average duration of symptoms was 1.9 years. All were proven cases of pulmonary tuberculosis; tubercle bacilli were found in the sputum in 33, (73.3%) of the cases. Cardiac abnormality was found to be present in 23 (51.1%) instances.

The age distribution of the entire series is shown in the following table. (Table VI).

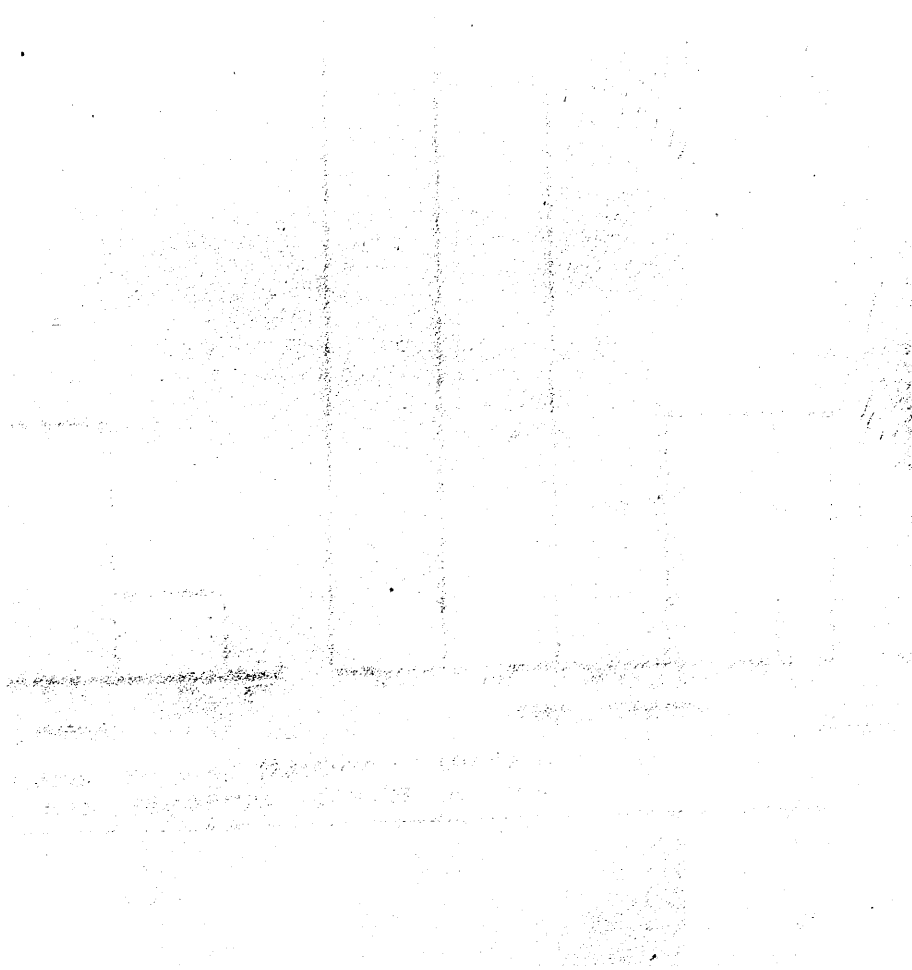
TABLE VI.

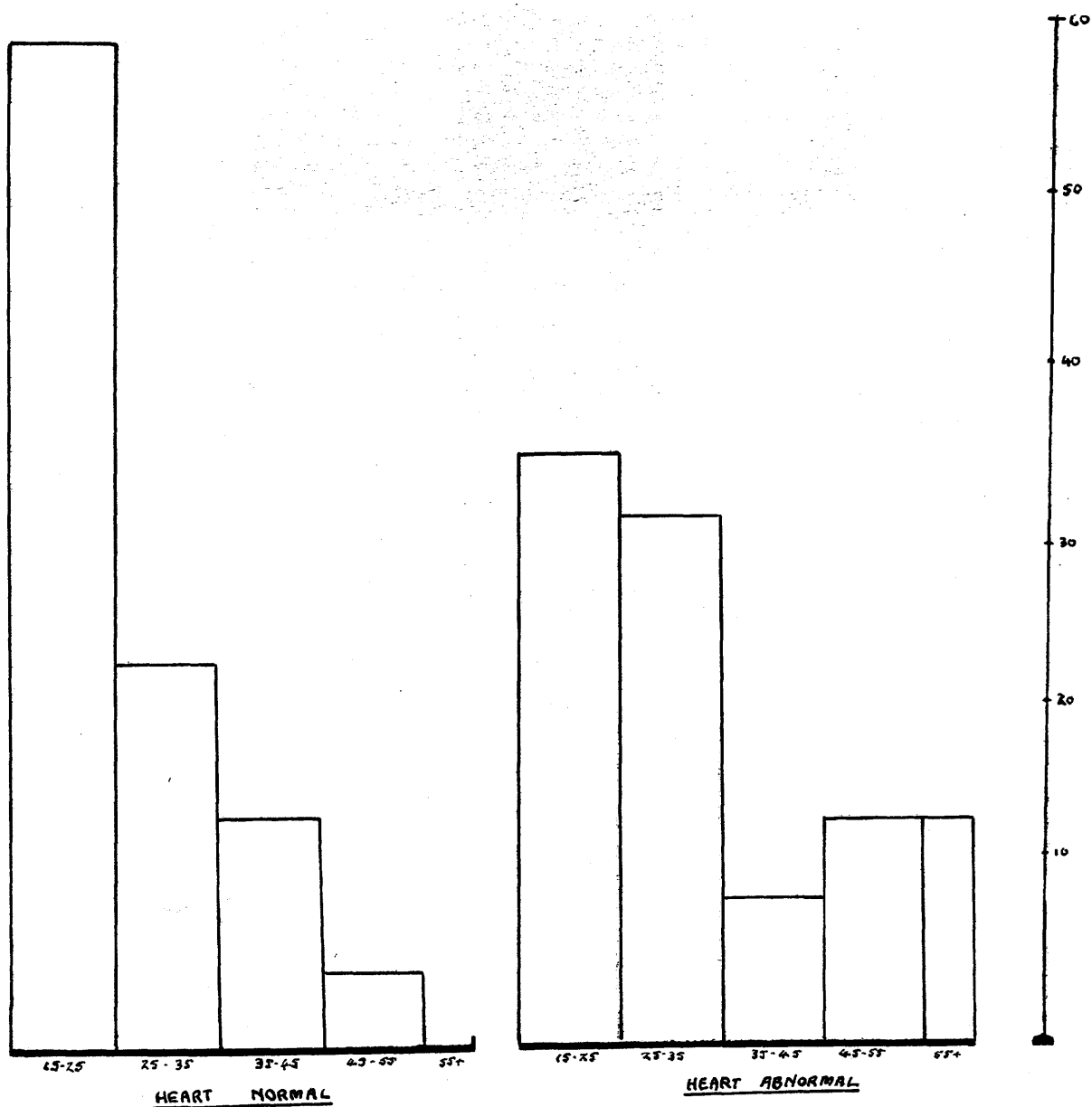
Age-group.	Males.	Females.	Total.	Percentage.
15 - 24	11	10	21	46.67
25 - 34	9	3	12	26.67
35 - 44	3	2	5	11.11
45 - 54	3	1	4	8.89
55 and over.	3	0	3	6.67

It will be noted that males predominate, and that the majority of patients were young adults.

The even distribution of age-groups is less well marked when the series was divided into two groups, namely

those in which the heart was normal, and those in which it was abnormal. The behaviour at ages of these groups is well shown in the following histogram.





HISTOGRAMS SHOWING PERCENTAGE COMPOSITION OF NORMAL AND ABNORMAL GROUPS, AT AGES.

In order to compare the various factors which might influence the heart adventitiously, the following table has been constructed. (Table VII).

TABLE VII.

	Heart Normal 48.9%	Heart Abnormal 51.1%
Percentage males	68.2	60.9
Percentage females	31.8	39.1
Average age in years	27.3	33.3
Average duration of symptoms	1.87	1.94
Percentage doing Heavy work	27.3	43.4
Percentage with tachycardia	59.	65.
Percentage febrile	45.	30.4
Percentage with hypotension	13.6	26.

It will thus be seen that the two groups bear comparison in all but two factors, namely that a higher percentage of cardiac abnormality occurred in those cases exhibiting hypotension, and in those engaged in heavy occupations. These factors would appear to be mutually contradictory!

In the 22 normal cases, inversion of the T wave in Lead III occurred in 5. (22.7%).

Of the 23 abnormal cases, 15 (65.2%) exhibited a single abnormality, while 8 (34.8%) had a double abnormality.

The following three tables (VIII, IX & X) show the distribution of these abnormalities.

TABLE VIII.

Type of Abnormality.	Frequency.	Percentage.
Single.	15	65.2
Low voltage. Lead I	10	66.66
Low voltage. Lead III	1	6.33
Left Axis Deviation.	3	20.0
Right Axis Deviation	1	6.33

TABLE IX.

Type of Abnormality.	Frequency	Percentage
Double.	8	34.8
Low voltage. Lead I & Inverted T.III.	1	12.5
Low voltage. Lead II & Inverted T.III.	1	12.5
Low voltage. Lead I & Low voltage. Lead III	1	12.5
Low voltage. Lead III & Left axis deviation.	1	12.5
Low voltage. Lead I & Right axis deviation	2	25.
Inverted T.II & Inverted T.III.	1	12.5
Inverted T.III & Right axis deviation	1	12.5

TABLE X.

Type of Abnormality.	Frequency.	Percentage.
Low voltage. Lead I.	14	45.16
Low voltage. Lead II	1	3.23
Low voltage. Lead III	3	9.68
Left axis deviation.	4	12.9
Right axis deviation.	4	12.9
Inverted T.II.	1	3.23
Inverted T.III.	4	12.9

From these frequency distributions, it will be seen that the commonest abnormality was Low voltage in Lead I. Axis deviation came next in order.

Table XI shows the relationship of asthenic and sthenic hearts to electrocardiographic abnormality. There were no cases in which the heart was hypersthenic.

TABLE XI.

	Heart Asthenic. No. of cases.	Heart Sthenic. No. of cases.
Electro. normal.	5	17
Electro. abnormal.	9	14

The nature of the abnormality occurring in the asthenic and sthenic groups is shown in Table XII.

TABLE XII.

	Low Voltage.			R.A.D.	L.A.D.	Inv.T.II.	Inv.T.III.
	I.	II.	III.				
Heart Asthenic. (No. of cases)	7	1	0	3	0	0	1
Heart Sthenic. (No. of cases)	7	2	1	1	4	1	8

The remaining two tables (Tables XIII and XIV) show the relationship between the extent of pulmonary involvement, the size of the heart and the type of cardiac abnormality present. In only seven cases was the pulmonary lesion unilateral; when it was so, the right side was invariably involved.

TABLE XIII.

	Unilateral.	Bilateral.	Less than 3 Zones.	More than 3 Zones.
Heart Asthenic.	4	16	4	15
Heart Sthenic.	3	22	7	18

TABLE XIV.

	Unilateral.	Bilateral.	Less than 3 Zones.	More than 3 Zones.
Low.Volt. I.	3	10	3	10
Low.Volt. II.	0	3	0	3
Low.Volt. III.	0	1	0	1
R.A.D.	1	3	1	3
L.A.D.	2	2	2	2
Inv. T.II.	0	1	0	1
Inv. T.III.	1	8	3	2

Blood pressure. Hypertension occurred once in the series, in the sthenic group. The electrocardiogram was normal. Hypotension was present in 9 (20%) cases. In three, the

electrocardiogram was normal. In five out of the six "abnormal" instances, the heart was sthenic, and in three "normal" instances, the heart was also sthenic.

Low voltage was present in the electrocardiograms, in all six of the "abnormal" group, and in two, Right axis deviation also was present.

CONCLUSIONS.

CONCLUSIONS.

Some years ago various authorities gave their estimation, from clinical and pathological experience, of the frequency with which the heart was affected in pulmonary tuberculosis. When the average findings of these earlier workers has been weighted, it amounted to 2.31%. By the assistance of radiology, the percentage of discernible cardiac abnormality rose to 8.6%. More recently, over a large series of cases, a number of workers have shown that a weighted average of 38.87% of all cases of pulmonary tuberculosis have abnormal hearts. (See appendix, page 164). These figures are statistically significant, and demonstrate irrefutably the superiority of electrocardiography as a means of detection of cardiac abnormality in this condition.

We may thus conclude quite definitely that cardiac abnormality occurs in pulmonary tuberculosis with much greater frequency than was previously supposed, and that we have a ready means of its detection.

When we attempt to show the underlying causes of such a high proportion of cardiac affection, we are on less sure

ground. Certain rare conditions, such as tuberculous affection of the myocardium can immediately be dismissed. Cardiac displacement cannot be held to account for it in any way. Clinical experience of allied conditions, and experimental evidence has shown that all but the most extensive intrapulmonary destruction, or fibrosis, does not cause cardiac change by the simple raising of intrapulmonary blood pressure.

The age or sex of the patient appear to have little effect in the production cardiac abnormality, nor is it dependent upon the duration of the tuberculous process. There is some slight evidence that those who engage in heavy work are more prone to cardiac involvement than those who engage in light work, but surely this holds good in almost every form of ailment.

Every worker in this field, has found in his abnormal cases, evidence of myocardial involvement, shown by such features as low voltage, inversion of the T waves, or prolongation of the PR interval. The same findings occur again, and we are faced anew with the postulates that:-

- (a) There exists a constitutionally asthenic heart which predisposes in some way to a tuberculous infection of the lungs.
- (b) That the heart is poorly nourished in pulmonary tuberculosis.
- (c) That Pulmonary tuberculosis produces a toxic effect on the myocardium.

The present series of cases shows quite clearly that cardiac abnormality occurs with equal, if not with even greater frequency in persons whose hearts are of normal size, than in those whose heart conforms to the asthenic type.

Inadequate nutrition of the cardiac musculature must surely result from either the lessened, or the impoverished blood supply to that organ. Some mild degree of anaemia is not infrequently found in cases of pulmonary tuberculosis, but just as frequently the patient is full blooded. On the other hand, many cases of advanced pulmonary tuberculosis of several years' standing show no evidence of cardiac abnormality whatsoever.

When the detective of fiction has eliminated every suspect but one, he has to accept that one as the true villain of the piece, even though his evidence be slender.

In the same way, we are forced, in the absence of other suspects, to accept the conclusion that in pulmonary tuberculosis, the heart is affected by some toxic process, the precise nature of which, and the mode of action of which remains for the present unknown. We do know that it is possible to separate tuberculous patients into two groups, namely those in which the heart is affected and those in which it remains free. From this point we may start to investigate more fully the perils and dangers which face the thoracic surgeon, but this brings us beyond the scope of the present investigation.

December, 1936.

APPENDIX.

APPENDIX I.

1. Calculation of the Coefficient of correlation between the modal average temperature "T" and the modal average pulse rate "P".

Arbitrary origin T.98.

Arbitrary origin P.85.

Case	Tx.	T.	Tx ²	Px	P.	Px ²	TP.
1	1.	99.	1.	-1	84	1	-1.
2	0	98.	0	-15	70	225	0
3	0	98.	0	-1	84	1	0
4	0	98.	0	-25	60	625	0
5	-.4	97.6	.16	-21	64	441	8.4
6	.4	98.4	.16	-5	80	25	-2.
7	2.4	100.4	5.76	15	100	225	36.
8	1.	99.	1.	3	88	9	3.
9	-1.	97.	1.	-5	80	25	5.
10	.2	98.2	.04	3	88	9	.6
11	-.6	97.4	.36	-25	60	625	15.
12	.4	98.4	.16	17	102	289	6.8
13	0	98.	0	-13	72	169	0
14	1.2	99.2	1.44	-3	82	9	-3.6
15	.8	98.8	.64	-1	84	1	-.8
16	.8	98.8	.64	-9	76	81	-7.2
17	1.4	99.4	1.96	-9	76	81	-12.6
18	1.	99.	1.	15	100	225	15.
19	2.5	100.5	6.25	35	120	1225	87.5
20	-.4	97.6	.16	23	108	529	-9.2
21	.4	98.4	.16	3	88	9	1.2
22	3.	101.	9.	27	112	729	81.
23	-.4	97.6	.16	15	100	225	-6.
24	1.2	99.2	1.44	5	90	25	6.
25	-.6	97.4	.36	-5	80	25	3.
26	-.4	97.6	.16	31	116	961	-12.4
27	1.	99.	1.	-5	80	25	-5.
28	0	98.	0	7	92	49	0
29	-.4	97.6	.16	-1	84	1	.4
30	-.6	87.4	.36	-9	76	81	5.4
31	1.	99.	1.	-5	80	25	-5.
32	1.4	99.4	1.96	15	100	225	21.
33	0	98.	0	19	104	361	0
34	.4	98.4	.16	-3	82	9	-1.2
35	1.2	99.2	1.44	31	116	961	37.2
36	-.8	97.2	.64	-13	72	169	10.4
37	-.2	97.8	.04	31	116	961	-6.2
38	-.4	97.6	.16	-15	70	225	6.
39	0	98.	0	-13	72	169	0
40	-1.	97.	1.	14	99	196	-14.
41	-1.2	96.8	1.44	15	100	225	-18.
42	.4	98.4	.16	-5	80	25	-2.
43	-.2	97.8	.04	-7	78	49	1.4
44	1.8	99.8	3.24	-1	84	1	-1.8
45	1.4	99.4	1.96	33	118	1089	46.2

TOTALS +26.3

+47.77

+357

+11640

+396.5

APPENDIX 2.

Coefficient of correlation between temperature and pulse rate (contd.).

Arbitrary origin T. 98		Arbitrary Origin P.85		
2		2		
Tx.	Tx	Px.	Px	TP
26.3	47.77	357	11640	396.5
<u>-8.6</u>		<u>-215</u>		<u>-108.0</u>
+17.7		+142		+288.5
N = 45		N = 45		ETP = 288.5
ET = 17.7		EP = 142		ETP/N = 6.4111
2		2		
ET = 47.7		EP = 11640		
ET/N = .3933		EP/N = 3.1556		
Mean T = 98.39		Mean P = 88.16		
2		2		
ET/N = 1.0616		EP/N = 258.6667		

Standard deviation Temperature

Standard deviation Pulse Rate

$$= \sqrt{1.0616 - (.3933)^2}$$

$$= \sqrt{258.6667 - (3.1556)^2}$$

$$= \sqrt{.906915}$$

$$= \sqrt{248.708889}$$

$$= .9523$$

$$= 15.7705$$

∴ "r", or coefficient of correlation between T and P

$$= \frac{ETP/N - (ET/N \times EP/N)}{SD T \times SD P}$$

$$= \frac{6.4111 - (.3933 \times 3.1556)}{.9523 \times 15.7705}$$

$$= +.344$$

$$\text{Standard Error of "r"} = \frac{1 - r^2}{\sqrt{N}} = .132$$

Summary. Mean temperature = 98.39
Mean pulse-rate = 88.16

APPENDIX 3.

Coefficient of corelation between temperature and pulse rate (contd.)

SUMMARY.

Coefficient of corelation between the modal average temperature and the modal average pulse rate $+.344$, with a standard error of $.132$, in 45 observations.

APPENDIX 4.

II. Calculation of the significance of the three methods of detection of cardiac abnormality in pulmonary tuberculosis, viz. A. Clinical and pathological; B. By radiology; and C. By electrocardiography.

A. Authority	No.	%abnormal	No. abnormal	
1. Brown.	7115	.9	64	Mean % Abnormal = 2.31 Standard error = .117
2. Norris	8154	3.5	285	
3. Colthorp.	1097	2.6	29	
	<u>16366</u>		<u>378</u>	
B. 1. Schmidt.	750	8.6	65	Mean % abnormal = 8.6 Standard error = 1.024
C. 1. Boas & Mann.	97	59	57	Mean % abnormal = 38.87 Standard Error = 2.049
2. King & Hansen.	100	63	63	
3. Heaton.	304	22.4	68	
4. Matsumoto & Hoshi.	20	45	9	
5. Present series.	45	51.1	23	
	<u>566</u>		<u>220</u>	

Difference of A & B.

A.	16366	2.31	378	Mean % of A & B = 2.59
B.	750	8.60	65	
	<u>17116</u>		<u>443</u>	

Diff. 6.29 Standard Error of Difference:-

$$= \sqrt{2.59 \times 97.41 (1/16366 + 1/750)}$$

$$= .539 \quad \text{But Difference/Standard Error} \\ 10.61 \quad \text{(greater than twice SE of difference).}$$

Result. SIGNIFICANT.

Difference of A & C.

APPENDIX 5.

Difference of A & C.

	No.	% abnormal.	No. abnormal	
A.	16366	2.31	378	Mean % of A & C = 3.53
C.	<u>566</u>	38.87	<u>220</u>	
	16932		598	

Diff. 36.56 Standard Error of Difference:-

$$= \sqrt{3.53 \times 96.47 (1/16366 + 1/566)}$$

$$= .789 \quad \text{But Difference/Standard Error} \\ = 46.34$$

Result. SIGNIFICANT.

Difference of B & C.

B.	750	8.6	65	Mean % of B & C = 21.66
C.	<u>566</u>	38.87	<u>220</u>	
	1316		285	

Diff. 30.27 Standard Error of Difference:-

$$= \sqrt{21.66 \times 78.34 (1/750 + 1/566)}$$

$$= 2.294 \quad \text{But Difference/Standard Error} \\ = 13.20$$

Result. SIGNIFICANT.

Formula used in above calculations:-

Let N = the number of observations.

Let p = the mean % of A & B (or C)

Let q = 100 - p.

Then the Standard Error of the Difference is found from:-

$$SE = \sqrt{pq(1/N_a + 1/N_b)}$$

Where the ratio of the Difference in %s to the Standard Error exceeds 2, the result is considered statistically significant.

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