

## **The soldier's heart and the effort syndrome / by Thomas Lewis.**

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THE  
SOLDIER'S  
HEART  
AND THE  
EFFORT SYNDROME

THOMAS LEWIS

TRO  
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/LEW



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THE  
SOLDIER'S HEART  
AND THE  
EFFORT SYNDROME

BY

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1918.



BY THE SAME AUTHOR.

"The Mechanism of the Heart Beat."

"Clinical Disorders of the Heart Beat."

"Lectures on the Heart."

"Clinical Electrocardiography."

TRO

RAMC

Gall.

/LEW

## PREFACE.

**T**HIS small book is not intended as a medical or pathological treatise. It is largely a collection of such information as I have found it necessary to convey to medical officers or deputy commissioners working under my direction or posted for instruction at this hospital, and I have attempted to weave this information around views which have been most frequent topics of conversation in our mess at Colchester. It is written primarily with the intention of helping medical officers of recruiting, discharging and pensioning boards, and medical men or officers in charge of patients.

In dealing with physical signs, those have been chosen for comment as it is thought desirable to discuss ; to deal exhaustively with the signs of heart disease and its differential diagnosis has not been my purpose. In selecting I have been guided by the difficulties



experienced by myself and my colleagues during the past few years and by the result of observation directed to overcome these difficulties. When a question is sufficiently often repeated, it becomes expedient to answer it in a more public manner. In dealing with some questions I am aware that I have written somewhat dogmatically perhaps—the faith that is in me for the moment, and that more than one subject is touched upon which has been debated keenly. From critical readers I crave a measure of indulgence, praying them to bear in mind that in this book are views which have been tinged with a war purpose; the practice of military prognosis has taught the urgent need of definiteness. A medical man does well who pins his faith to clear signs of disease, discountenancing such signs as are of more dubious value. Another consideration affects the views expressed to a not unimportant extent, it is that the value of a method of diagnosis is to be assessed, not by the success with which it is employed in specially trained hands, but by its success when employed by

the average medical man. When a professed expert introduces a new diagnostic test or revives an old one, even though he may be able to show that in his hands it has great value, which is not always the case, yet by its advertisement he will do more harm than good unless he is able to state the method of his test so clearly, and unless the test is so simple, that it is easily acquired and used by the majority of his professional brethren. Assuredly the method will be attempted on his authority, whether rightly used or not; as is perfectly well known in specific instances, the test may be improperly applied and quite erroneous conclusions drawn from it. I allude especially to methods of estimating the size of the heart and to the close differentiation of various types of cardiac murmur which are treated at some length. I also allude to special tests of the capacity of the heart for work and to methods of estimating the intensity of the heart sounds; of both these last methods of testing the heart I have had experience; I do not believe that either has an appreciable value in ordinary



practice. In regard to electrocardiography, I would say that it has its value in elucidating irregularities on occasion, but that its indiscriminate use is much to be deplored. The medical officer can do perfectly well without either electrocardiograph or polygraph ; we use both instruments at this hospital, but neither influences treatment or prognosis in one case in a hundred of the class with which we deal.

Although the main subject matter relates to derangements, real or supposed, of the cardio-vascular system, and although the clinical observations have been undertaken chiefly upon and chiefly concern soldiers sent to hospital under such a diagnosis as "disordered action of the heart" or "valvular disease of the heart," yet if we are to reap the full benefit of our experiences during this war, these experiences are to be treated on a broader basis ; to possess them of permanent value they are to be correlated with the experiences of civilian life ; if it is possible, it is important that some prognostic and therapeutic lessons be learnt which are of general application.

I have emphasised the symptom group to which the term "effort syndrome" is applied, hoping by so doing to draw more lasting attention to a group of symptoms which in combination indicate a commencing failure of the body's reserve of strength. For if we are to raid more fully that no-man's-land, the borderland of disease which is the hunting ground of the adventure-some, this syndrome will be a foe we shall often encounter.

It is now nearly three years since, working as a member of the Staff of the Medical Research Committee, I introduced at the Military Heart Hospital, Hampstead, a system of graded drills, and employed these remedially and as a means of justly grading soldiers returned to that hospital for supposed affections of the heart. My repeated contention that the surest means of gauging physical endurance is to test those suspected of lacking it by putting them to work has borne some fruit. The system devised has spread to many other military institutions at home and abroad and has received a wide measure of acceptance in the



Colonial Services and in those of our Allies. But it will be regrettable if, in the coming days of peace, we may not find the means to employ similar remedial measures and similar tests of a simple kind upon those manual workers in our midst who in their convalescence in our great civilian hospitals, or while they labour in the factories and workshops, look to our profession to tell them of their fitness or unfitness for their work and to help them towards the former state.

But for these matters, and some views on heart-failure and its causation, which I have long had in mind, and which these days of war have hindered me from pursuing as critically as I could have wished, the book is no more than it pretends to be—a collection of war-time notes.

For his kindly advice and careful revision of the proof sheets I am much indebted to my colleague, Captain H. J. Starling, R.A.M.C.

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COLCHESTER,

*September, 1918.*

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# CHAPTER I.

## INTRODUCTORY REMARKS.

During the present war sickness referred by Medical Officers of the Services to disturbances in the cardio-vascular system has been a chief malady. The prevalence of disorders classed for Army purposes under this anatomical system may be gauged from the published accounts\* which give the numbers of men discharged from the Army and Navy and pensioned up to the last day of May, 1918.

TABLE I.

Wounds and injuries	..	..	..	138,699
Chest complaints	..	..	..	41,155
"Heart disease"	..	..	..	36,569
Rheumatism	..	..	..	23,568
Nervous disease	..	..	..	21,288
Eyesight cases	..	..	..	10,195
Deafness	..	..	..	7,047
Epilepsy	..	..	..	3,697
Frost-bite	..	..	..	3,143
Insanity	..	..	..	2,816
Miscellaneous..	..	..	..	69,988
				<hr/> 358,160

The figure for cardio-vascular disease is the second amongst medical ailments ; it comprises two chief groups of patients, namely, those discharged for "disordered action of the heart" (D.A.H.) and those discharged for "valvular disease of the heart" (V.D.H.). As at least one such patient has been retained in the Army for every man discharged, no

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\* "Reveille." August, 1918.



less than 70,000 soldiers have reported sick and have been classed as cardio-vascular since the war started. There were certainly no less than 20,000 of these cases in our home hospitals recently or on the lighter forms of duty. These figures are sufficient to show the magnitude of the problem with which we still have to deal. The letters "D.A.H." and "V.D.H." are often used without much discrimination, for they are undefined; but from statistics it may be calculated that of all men returned to hospital for cardio-vascular complaints approximately 1 case in 10 has been a sufferer from structural or actual heart disease. Because of its numerical importance it is with the larger group that I shall mainly deal. But before proceeding to do so it may be well in the interest of clear expression to define such terms as I am about to employ.

The term "*disordered action of the heart*," or "D.A.H." as it is spoken and written in abbreviation, is purely an Army term. I shall use it in precisely the sense in which it is employed in the Army generally. In speaking of "D.A.H." cases I shall be speaking of a group of men sent to hospital with this diagnosis. It may be well therefore to pause and inquire of what such a group actually consists. An unselected group of 370 patients returned to us with this diagnosis between May and August, 1918, is tabulated.\*

TABLE II.

370 returned as "D. A. H."				277 returned as "V. D. H."			
"Effort syndrome"	..	..	355	"Effort syndrome"	..	..	161
Aortic disease	..	..	2	Aortic disease	..	..	45
Aortic disease and mitral stenosis	1			Mitral stenosis	..	..	39
Enlarged heart	..	..	3	Aortic disease and mitral			
Mitral stenosis	..	..	4	stenosis	..	..	15
Arterio-sclerosis	..	..	1	Enlargement	..	..	7
Pulmonary tuberculosis	..	..	2	Other heart conditions	..	..	5
Neurosis	..	..	1	Pulmonary tuberculosis	..	..	2
Gonorrhœa	..	..	1	Other general diseases	..	..	3

\* This group is purely of expeditionary force cases; each man had passed through the hands of a number of medical officers and the diagnosis had been subject to repeated revision before he came to us.



The term "V.D.H." I treat similarly, using it purely in its Army sense. An unselected group of these men is also tabulated.

The majority is comprised by patients who show no clear signs of structural heart disease but fall under the heading of "effort syndrome," a term defined presently.

The terms "D.A.H." and "V.D.H." are open to such serious objections\* that I shall not attempt to define them further than they are defined by this table, but I shall introduce the chief subject matter of this book from a different standpoint.

When a healthy man takes exercise, and this exercise is sufficiently stressful or prolonged, he becomes aware at the time of the effort, or after it has ceased, of certain symptoms and he presents certain physical signs. The most notable of his symptoms is breathlessness, a symptom which comes during the exercise and continues with diminishing intensity for a variable period afterwards. During the exercise, consciousness of the heart beat may come, giddiness or actual faintness or fatigue may be added. At the cessation of the exercise, aching of the limbs, tremulousness and exhaustion are experienced; at a later period, stiffness of the muscles; a feeling of lassitude and sometimes actual malaise and tremulousness are noticed. In cases of extreme effort, pain over the precordial region, at first aching but exceptionally more violent and widespread, may be felt. During the period of exercise the heart rate and blood pressure are raised; the alæ nasi are dilated, the accessory muscles of respiration are brought into action to increase the tidal

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\* A chief objection to the term "D.A.H." is the careless and perfunctory manner in which it has been used in front line work. Of the "D.A.H." group in the left hand part of Table II, the number in which lesions were discovered was not great. At the convalescent depôts in France the number has been greater. The term "V.D.H." is in general use to include all manner of heart affections, valvular and otherwise, and includes the greater part of all patients who present systolic murmurs, irrespective of the origin of these murmurs.



flow of air. To these physiological symptoms and signs briefly described as a group I apply the term "*physiological syndrome of effort*." The term is used as a convenient description of the chief changes, subjective or objective, which are manifested by the human body in its reaction to exercise ; and one purpose in introducing it is to emphasise a working hypothesis at which I have arrived, namely, that a large number of patients, especially soldier patients, who come under observation, report sick, or are regarded as sick, because they notice or present such a series of symptoms and signs. When I use the term "effort syndrome" I have in mind the symptoms and signs which follow exercise in health ; but I believe that I recognise the same or a very similar group of symptoms and signs in a large class of patients in ill-health. In patients of this class, if no signs of disease are anywhere discovered, I say that they suffer from the "effort syndrome." The difference in symptomatology which exists between health and this form of ill-health is largely a difference in degree ; the gauge is the amount of work which, performed in a given space of time, will provoke the symptoms. Symptoms produced in normal subjects by excessive work are produced in the patients by lesser amounts ; the smaller amount of work required, the more severe the malady. Naturally there is no sharp line of division ; there is in a large group of patients a perfect grading from the healthy man to him who is seriously unwell. We are travelling in the borderland between health and disease. This point of view has its value ; it directs investigation towards the normal reactions of the body to exercise and to the corresponding reactions in disease ; it brings us to inquire into the reserves of some of the most important bodily functions, and into the manner in which these reserves are reduced.

The term "effort syndrome" as applied to cases in this book is not equivalent to the term "irritable heart,"



“soldier’s heart,” etc.,\* since each of these terms purports to constitute a diagnosis ; it is used solely to express a group of symptoms and signs, independently of the manner in which these are brought about or the disease from which the patient actually suffers ; but its use is restricted to those patients in whom the diagnosis is not yet accomplished. To illustrate, the clear example of early pulmonary tuberculosis may be employed. Many patients afflicted by this disease in its earliest stages suffer from the symptoms under consideration ; breathlessness, palpitation, precordial pain, giddiness or faintness, easy fatigue or actual exhaustion are prominent during or after exercise. These patients have the “effort syndrome” ; provisionally I would apply the term to their complaint, though naturally it would be abandoned as soon as the true nature of the malady became clear. The reactions of the body to exercise are also exaggerated in those who are in process of returning to complete health, such as convalescents from acute infectious illnesses. Breathlessness, fatigue, tremulousness and palpitation, the last resulting from rapid heart action, accompany physical efforts which are accomplished without discomfort in health.

That the power to continue strenuous exercise is limited in health by symptoms of oncoming distress is known to everyone ; but it seems not to have been recognised clearly that the same symptoms occurring in people whose health is below the standard of normality are not necessarily in themselves criteria of ill-health ; the index of ill-health is the relatively small amount of work performed which will elicit discomfort. The distinction is important ; for if it be not understood, the symptoms are themselves regarded as constituting a departure from the normal. Being in

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\* I do not use these terms in this book for the reason that they convey the meaning of a primary cardiac disorder.



large part physiological sensations, they may not be regarded as intrinsically abnormal; the abnormality lies in the circumstances in which they arise, in the demonstrated lack of reserve.

There is now no doubt at all in my mind that in dealing with patients who are afflicted with the "effort syndrome" we are dealing with a very mixed group, the chief classes of which are probably as follows:—

1. One of the largest groups is that of constitutional weakness, nervous or physical or both. In this group are many who show incomplete or imperfect development. To it belong many undersized men, many with flat or elongated chests and instances of infantilism; to the same group belong many with family histories tainted by insanity or epilepsy, and those who in childhood were nervous weaklings, bed-wetters, somnambulists, etc.

2. Another large group comprises those who may be regarded as played out by exposure, hard continuous work, disturbed sleep and by the constant strain and jar to body and nervous system which work in the front line brings, but in whom a constitutional weakness is difficult to determine.

3. A third chief group comprises patients who may be regarded as exhibiting delayed convalescence from acute illnesses such as rheumatic fever, pneumonia, pleurisy, dysentery, trench fever, severe influenza or tonsillitis.

4. A not inconsiderable group, though its size is still indeterminate, is that comprising actual though unrecognised infection, including incipient tuberculosis,\* local pus infections, infections of the intestinal tract.

5. A small group in home hospitals is that of delay in recovery from gas poisoning.

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\* It seems not improbable that a number of "effort syndrome" patients may be in reality incipient and *healing* tuberculosis.



6. A small group is that in which incipient but unrecognised heart disease is present.

In each and all of these groups breathlessness, fatigue, and the remaining symptoms are induced by abnormally small effort. In all groups the subjective symptoms at present appear to be similar or the same.

When the young manhood of a whole nation is placed suddenly under arms, its whole habit of life, its housing, dietary and clothing, its times of rest and of work, the nature of its employment changed, when with little or no preparation it is submitted by such a war as this to enforced training of a strenuous kind, when subsequently it is sent to meet wholly unusual and unnatural conditions, which stretch each muscle fibre and vibrate each nerve cell and nerve fibre of the body to the full, then the manhood is submitted to a most drastic test. Who then can affect surprise if many men fail when so tested? The test in its entirety selects, it selects the weaklings in the general sense and marks them down. It grasps those who lack physical strength or nervous stability; it grasps those seemingly in full health and yet the subjects of incipient disease. It grasps them, and shortly it makes or breaks them. Many it breaks at once, some it breaks only in the end. Healthy men break when the trial is too long continued; there is a limit to the endurance of each and all. The test emphasises a recognised defect; it confirms a suspected or discovers an unsuspected weakness; that is its general method. But often it sifts unfairly, submitting its victims to wholly unnatural strains or accidents. A band of men is swept by poisonous fumes and all inhale them equally; some perish, some survive. It is not always those resistant to the natural strains of life who survive, nor those who lack the natural powers of endurance who perish; the test is unusual and therefore unnatural; nevertheless, in general the strong will suffer less



than the weak and recovery in the strong will advance further to completion ; in the weak the experience will often leave an enduring aftermath, or will call forth in aggravated form a previously experienced disability. Yet the "effort syndrome" is not peculiarly a soldier's malady, it is only just permissible to speak of it as specially a soldier's malady ; its apparent frequency in soldiers is chiefly, if it is not entirely, due to its unveiling by circumstances which the civilian does not meet. It is a common condition amongst the civilian populace ; it affects children and women as well as grown men.

It is the apparent diversity of *cause* which makes the syndrome so extraordinarily difficult to investigate. We are often in the borderland of disease, probably of many diseases ; and when we understand the syndrome in all patients we shall have knowledge which extends throughout the domain of medicine.

But while a complete pathological understanding is far away, yet we may deal with these patients, sorting them and treating them upon modern lines. Though the pathology is difficult, the practical problems connected with this malady or maladies are not insoluble.

The picture which I have here attempted, no final picture let me say at once, is in many ways a picture without a central motive to fix the attention ; it is perhaps better that it should be painted so ; for if the "effort syndrome" is regarded as due to a specific form of disease, the right attitude towards the individual patient is at once lost. That attitude is one of deferred judgment, an attitude of inquiry. When, therefore, I treat these cases as a class, I do so because the needs of the moment enforce such treatment ; it is the manner in which the cases may be most conveniently described ; it is the most opportune plan so far devised for dealing with them in a broad way. Each case should come to the medical officer on its own merits, and the very use of a

term which describes symptoms rather than disease goes far to introduce and perpetuate this attitude of inquiry.

If we study a group of soldier patients and follow them for months or for years we shall weed out a proportion—small though it be—in whom we can more definitely name the disease. That is a universal experience. Some few, at a later date, show manifest signs of mitral stenosis or of aortic insufficiency, some few develop recognisable signs of pulmonary tuberculosis, a very few become obvious sufferers from exophthalmic goitre, in a few a chronic appendicitis or cholecystitis unveils itself in more acute symptoms, and in a very few chronic syphilis is discovered. In other words, as time goes by the group begins to fall to pieces and the patients to rearrange themselves for diagnostic purposes. A goodly proportion of the patients, as time goes by, leaves it to form a group “restored to health.”



## CHAPTER II.

### THE "EFFORT SYNDROME," ITS SYMPTOMS AND SIGNS, CONTRASTED WITH THOSE OF HEART DISEASE.

#### *Breathlessness.*

In the following pages I purpose to describe the symptoms and signs which constitute the "effort syndrome," dealing with each symptom and sign also from the standpoint of differentiating real and supposed heart maladies.

Breathlessness is an almost universal complaint amongst patients admitted to hospital under the Army diagnoses of "D.A.H." and "V.D.H.," though it is variable both in its degree and in its type. The patient may be breathless when at absolute rest; this is comparatively rare. There may be slight breathlessness when the patient is walking quietly about the wards; this is not uncommon. Lastly, breathlessness is experienced on exertion; this is almost universal in the patients on admission. In the last groups the reserve is diminished; in the first group it is abolished.

The causes of breathlessness amongst our soldier patients as a body are several and it is well to distinguish certain clinical types.

1. Breathlessness which is due to *deficient aeration of the blood* is accompanied by cyanosis, slight, moderate or deep, according to the urgency of the dyspnœa. The

excursion of the chest is greater and is also more frequent than normal; it is often irregular in rhythm. This type of breathlessness is rare in our patients; when it occurs, serious structural changes in the heart are to be found and the veins of the neck are swollen and the liver is engorged. It is said to be produced by loss of alveolar space; the capillaries of the lungs are engorged and encroach upon the air space (Peabody). The medical officer should ponder on the clinical relation of breathlessness and cyanosis. When a patient rests in bed and has no cause for breathlessness other than a deficient aeration of the blood, conspicuous breathlessness will be absent unless the patient is deeply cyanosed. If, therefore, a patient shows conspicuous breathlessness, *cyanosis being absent or slight*, it is certain that some cause of breathlessness is present other than such a defect in the circulation as would induce deficient blood aeration. The same rule may be applied whether the patient is in bed or is up and about, but in the last cases it is to be remembered that local cyanosis of the hands, and in cold weather cyanosis of the ears and nose, is frequent in patients who present no sign of structural disease.

*Breathlessness of purely cardiac origin is always accompanied by general cyanosis, slight, moderate or extreme.*

In patients who are the subjects of early mitral stenosis and aortic disease, breathlessness is often conspicuous by its absence. In many of these patients exercise is well tolerated; in many who experience breathlessness the symptom is not of cardiac origin, but owes its existence to the same causes as does the breathlessness of the "effort syndrome" group of cases.

2. In a type of case which is very rare in military hospital practice but is common in civilian practice, urgent breathlessness may be present in the complete absence of cyanosis, and *the hurried breathing is maintained in sleep.*



These are bed patients and often Cheyne-Stokes breathing is discovered in them. For the most part these show signs of renal deficiency, though cardiac lesions are often associated with the last. The breathlessness is due to relative acidity of the blood (there being an excess of non-volatile acids).

3. Breathlessness persisting while the patient rests in bed is comparatively rare. Such patients belong for the most part to the bed types which I have already described.\* In the medical wards of military hospitals there is a third type. *The dyspnœa is confined to the waking moments.* Its type is rhythmic, shallow and rapid; the rate of respiration may be 50 or 60 to the minute. I have known it as high as 200 per minute. In such cases the breathlessness is to be ascribed primarily to the nervous system, and is often an hysterical manifestation.

4. The commonest type of breathlessness is that seen in the majority of patients in whom no structural lesion is to be discovered. It is not present when the patient is at absolute rest, but appears while he is up and about and especially when he exercises. The breathing may be rapid and shallow, or it may be of normal or somewhat increased rate and deepened. When a normal subject walks smartly up a flight of 40 steps, the respiratory rate is raised no more than a few cycles per minute. In patients who present the "effort syndrome" the reaction is exaggerated, and the respiratory rate may rise to 40, 50, 60 or even 70 per minute, or with a slight rise of rate it is deepened, by such a test.

The causes of this form of breathlessness are still *sub judice*, but are probably threefold, acting alone or in combination :—

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\* I omit reference to the breathlessness of the severe anæmias, of acute infections, and of lung disease. These patients do not come under observation as "heart" cases to any extent.



(a) In a few patients the vital capacity of the lungs is sufficiently reduced to account for breathlessness. The full expansion of the lungs is not used by men resting and in health ; there is a large reserve. In some few men, poorly built and with flat or narrow chests, this reserve is small, and being small is soon exhausted as inspiration deepens. Nevertheless, the vital capacity in the "effort syndrome" group is in the average only a little below normal (Wilson and Levine) and the chest measurements are only a little below those of peace time recruits of the same weight and height.

(b) In not a few patients the breathlessness is attributable to the nervous system or is aggravated by the condition of this system. To this last class belong patients who become breathless during medical examination or in response to sharp orders on drill, loud noises, etc.

(c) In many patients of the "effort syndrome" group, there is probably an alteration in the character of the blood. The blood reaction in health is alkaline ; it is equally or almost equally alkaline in these patients ; but, owing to a deficiency of certain blood constituents, it is said to approach more nearly towards an acid reaction than is normal, when small quantities of  $\text{CO}_2$  or lactic acid (such as are produced by exercise) are added to it (Barcroft). This approach to an acid reaction is at once signalled by breathlessness, the respiratory centre being extraordinarily sensitive to the blood reaction.

Genuine breathlessness is difficult to simulate ; it is accompanied by tightening of the accessory muscles of respiration, the face expresses anxiety, and the speech of the patient is disturbed by inspiratory movements. The breath cannot be held for any length of time, and if held the distress is afterwards exaggerated.

In "effort syndrome" cases of a moderately severe type who are up and about the breath cannot be held as a rule



more than 10 seconds; the changes in the alveolar air on exercise are similar to those seen in health (primary increase and subsequent decrease in the  $\text{CO}_2$  content), but they are brought about by much less severe test exercises (Drury).

### *Fatigue and exhaustion.*

Fatigue is an almost universal complaint of our patients. In the "effort syndrome" group it varies in degree and, when it can be gauged, is an excellent index of the severity of the affection. The mildest cases suffer such fatigue on exercise as would a healthy man who is out of training, in the severer cases it is experienced after very brief and simple exercises. Lassitude is especially prominent in the early morning and late afternoon. More rarely, fatigue on exercise proceeds to exhaustion; actual collapse from exhaustion on exercise is not seen because it is guarded against. Fatigue and the early signs of exhaustion appear objectively in the expression of the face and in the droop of the body; a material feeling of weakness is usually accompanied by uncontrollable tremor of the hands, or shakiness of the legs. The symptoms are those which are found in healthy subjects submitted to strenuous exercise. That they have the same origin is rendered probable by their association with a general feeling of malaise and in some patients with a rapidly developed and severe "stiffness" of the muscles.

### *Pain.*

Pain is a symptom complained of by half the patients admitted under the Army diagnoses of "D.A.H." and "V.D.H." Under the term pain, "effort syndrome" cases often include sensations of discomfort such as a feeling of tightness in the



chest or even the sensations to which a rapidly beating heart, acting against the chest wall, gives rise. Frequently the complaint is of pain in some part of the body well removed from the heart, for example, in the shins (where there has been a history of trench fever), in the back, in the shoulders or abdomen. By most patients it is referred to the left side of the chest. In some of these the pain occurs over the lower ribs on the left side, but more frequently it is referred definitely to the precordium. Pains of gastric origin are not infrequent. Of precordial pains, an ache or a feeling of soreness is the commonest; gnawing pain is less frequent; stabbing pains which may synchronise with the heart beats are sometimes described; very rarely also the pain is described as radiating into the neck, into the left arm or into the fingers. In almost all patients who experience these precordial pains the symptom is increased by exercise, in fact in most cases of genuine discomfort it is only present on or immediately after exercise.

Usually there is a foundation for the complaint; very often the degree of discomfort is exaggerated. Complaint of pain should rarely be allowed to weigh in estimating the fitness of these men or in assessing their disabilities. On several occasions, inexperienced medical officers have produced an epidemic of pain complaints in their wards by paying injudicious heed to such. Very few patients have such pain that they will willingly lie in bed to avoid it; yet, if encouraged to do so, patients will come to the examination room in some numbers, clasping their chests with their hands and complaining. While a plaint of pain is of little value, the presence of hyperæsthesia of the skin or muscles of the chest is of much value. It is to be found after exercise in a goodly proportion of the men. It may be present over an area of small extent, usually the region of the maximal heart thrust, or scattered over several small precordial areas. Most frequently it is



discovered over a wide skin area of the chest wall. The pectoral muscles are often tender when pinched, and sometimes the trapezii and sternomastoids are also implicated. In rare cases the skin of the inner side of the left arm is tender. But it is not unusual to encounter patients in whom the musculature of the whole chest, abdomen and even the limbs is tender when squeezed. Precordial tenderness is a valuable sign in that it corroborates a complaint of pain; but its presence must be elicited so far as possible without acquainting the patient that it is sought (see remarks on page 91). It is discovered more frequently in patients in whom there is a past history of rheumatic fever than in those in whom there is none, and the patients who present it are relatively intolerant to exercise.

In those rare cases in which the pain radiates to the left arm, it is necessary to differentiate the pain from that of grave angina pectoris (see page 77).

### *Palpitation.*

Palpitation or consciousness of the heart beat is a frequent complaint. In some patients it is produced by extrasystoles and then consists of an occasional feeling of discomfort in chest or throat, or as a detached thump of the heart; it is experienced for the most part during rest after exercise, and disappears entirely during actual exercise. In other patients (and these are rare) it is due to paroxysmal tachycardia (see page 74) or to auricular fibrillation (see page 73). In the great majority it is the result of rapid and energetic heart action, the normal rhythm being undisturbed. This form of palpitation is felt specially during exercise and under emotional excitement. It has no significance from a prognostic standpoint other than the significance of associated high pulse rate.



*Fainting.*

Amongst cases of the "effort syndrome," fainting is a not infrequent symptom. It may be the first symptom which the patient can remember ; it may have occurred on a single occasion or may have been repeated at intervals of weeks or months. Usually the provocative cause is unknown ; the man falls while standing still or while walking quietly and unalarmed. In other instances sudden alarm, as by machine gun or shell fire or slighter stimuli, has been responsible. In a few cases it has occurred during or immediately after an inoculation.

Many fainting attacks have now been witnessed. Where we have been convinced of the genuineness of the attack and that consciousness has been lost or greatly reduced, the attack has usually been of a perfectly definite type and due to inhibitory impulses. The following may be cited as an example :—

A young soldier, who presented the usual concomitant symptoms but no signs of structural disease, was sitting at rest in a chair ; a few c.c. of blood had just been withdrawn from a vein in the arm and the needle had been removed. There was no complaint of local pain, and he subsequently affirmed that the withdrawal of blood in no way distressed him. He began to feel queer, as though his "stomach had turned upside down ;" he became dizzy ; pallor was noticed ; his head fell forward to his knees. He was at once placed in a long easy chair and further observed. By this time pallor was intense and he was restless. The pulse was imperceptible, the heart sounds were distant, the rate of beating being 50 per minute ; the action was for the most part regular. From time to time there were retching movements, the pupils were little, if at all, dilated ; he was limp, mentally confused or actually unconscious for several



minutes. A heavy sweat broke out over the forehead and spread over the chest and body ; the pallor remained extreme ; respiration was slow and sighing. The pulse was imperceptible for several minutes ; as it returned the systolic blood pressure was registered (palpatory and auscultatory) at 60 mm. Hg.. A little later the pressure fell to 55 and then to 50, the pulse varying in rate between 50 and 60. Five minutes after the onset some recovery was noted, the pulse had risen to 64 and the blood pressure to 80. Nine minutes after the onset he was able to respond to questions (pulse rate 88, blood pressure 105). The blood pressure gradually rose to 110 mm. half an hour after the onset, and the man was able to leave the chair and walk supported across the room. The average blood pressure of this man in ordinary circumstances was 118, the pulse rate 80 to 90. He was shaky and exhausted for 36 hours subsequently. It was his second attack, the first having been experienced while saluting on guard duty.

This example is one of similar attacks witnessed in a number of patients ; in some they have followed the drawing of samples of blood, in some they have come without warning in patients standing and waiting routine examination. The simultaneous falls of pulse rate and blood pressure stamp the attacks as vagal in origin, a view fully confirmed by the occurrence of simultaneous gastric disturbances and by the observation that atropine at once raises the pulse rate.

Such attacks, when witnessed, can scarcely be mistaken for epilepsy. If the medical officer has to rely upon the patient's statements, then the onset with gastro-intestinal symptoms, the extreme pallor witnessed to by his friends, the presence of profuse sweating, the absence of tongue-biting and urination are important points. The fact that these attacks occur rarely if ever while the patient is in



bed or lying down is often helpful in coming to a correct view of the case and in differentiating it from epilepsy.

Fainting attacks associated with heart-block are so rare in soldiers as scarcely to merit consideration from the standpoint of differential diagnosis; fainting attacks in aortic disease are occasional.

The vagal attack has a limited significance in prognosis. If repeated it precludes, for the time being, return to work, in pursuing which a man endangers his own life or that of his fellows.

#### *Giddiness.*

This is a symptom complained of by three-fourths of the patients of the "effort syndrome" group. It is often experienced at the cessation of effort. The sensation is one of unsteadiness without rotation, and is accompanied by blurring of vision or by the appearance of a shower of bright points of light.

*Relation to postural change.*—The normal and permanent fall of systolic blood pressure in passing from the lying to standing position is variable, averaging 10 mm. Hg. in the brachial artery. In healthy subjects the *immediate* fall is little if at all greater. But in some patients, and especially those in whom there is giddiness on assuming the erect posture, the immediate change may be much more pronounced, in one case amounting to 30 or 40 mm. Hg..

In considering the effects of this fall of pressure upon the cerebral circulation it has to be borne in mind that there is in addition a fall of intracerebral pressure represented by the height of the column of blood (from heart to head) in all people when posture is changed. This normal static change of some 25 to 30 mm. Hg. becomes a fall of 55 to 70 mm. Hg. in exceptional circumstances and is presumably responsible for the symptom of giddiness. The oft-quoted syncope of



hutch rabbits, held a short while by the ears, is parallel. In some patients benefit is obtained by supporting the abdomen with a tight and broad abdominal binder.

But the question of postural giddiness in these soldiers is not always so simple as might appear from this account. There are instances of giddiness in which an excessive fall of blood pressure on standing is not to be observed ; moreover, there are rarer instances where giddiness is also experienced on lying down. A number of tested patients complained of equal giddiness when moved on a swingboard into the lying posture (yielding an immediate rise of pressure of 20 mm. in the arm and approximately 45 mm. in the head) and into the erect position. Where men have complained of spontaneous giddiness while standing, the blood pressure during the period of giddiness has sometimes been found reduced, but in several instances it has been raised (by as much as 20 or 25 mm.). Beyond the statement that postural giddiness in these patients seems to be associated with faulty distribution of the circulating blood during the period of giddiness, it is consequently impossible for the present to proceed.

*At the cessation of effort.*—During effort the systolic blood pressure is raised, muscular contractions force blood out of the veins, and the arteries become relatively overfilled. Immediately at the cessation of effort the potential reservoir in the veins takes up the blood, the supply to the heart falls away, and arterial pressure falls rapidly. In healthy subjects, after several minutes of hard work, the raised pressure falls at once to the original level at the cessation of work ; in patients the fall may be greater and may be sufficient to produce cerebral anæmia. In the cases considered, giddiness at the cessation of effort is common, actual loss of stability or momentary loss of consciousness is rarer but occurs from time to time.



These types of giddiness have little or no prognostic value. In patients who complain persistently of giddiness, the effects of simple tests, such as quick change of posture, should be observed.

Giddiness of the same type is not an infrequent symptom in cases of early structural heart disease, such as mitral stenosis and aortic valve lesions.

### *Headache.*

Headache, frontal and throbbing in type and often severe enough to send a man voluntarily to bed, is not uncommon. It is usually an after-symptom of exercise.

### *Sweating and other peripheral phenomena.*

Excessive sweating is frequent and it at times leads to complaint. It is frequently to be noticed in the palms of the hands while the patients are at rest, and it is a common experience to note sweat drops trickling from the axillæ while patients stand stripped in a cool or cold room. Relatively mild stimuli, such as easy exercise or emotion, may produce conspicuous sweating of the forehead and body ; in some patients a bedewed brow is almost constant, in a number the skin is greasy or actually moist. In a few patients the hands stream with perspiration during emotion and are always wet. Such soldiers complain that the sweat constantly rusts their rifles.

Not uncommonly there are other peripheral phenomena in the same class of patient. One of the most noteworthy of these is blueness or a flush, simple or of mottled colour, of the hands. It is present in a very large proportion of the patients and is usually associated with coldness of the extremities. Dermatographism (simple or urticarial) is very common. Numbness of the fingers accompanied by pallor and by pain is not rare ; in some cases it is sufficient



seriously to incapacitate, but I have never seen gangrenous scaling of the finger-tips in these men. In a very considerable percentage of the most seriously affected cases, myotactic irritability of the pectoral muscles is present to a conspicuous degree ; the trapezii, scapular muscles and biceps are usually involved at the same time.

#### *Heart rate.*

When cases presenting the "effort syndrome" are completely rested the average heart rate is about 85 per minute in unselected cases. In sleep the rates are for the most part normal.

In patients who are up and about the average is higher, being from 90 to 100 to the minute. Exceptionally, patients present rates of 120 or 130 per minute in the same circumstances, and very rarely the same rates may continue for weeks while the patients are in bed. As a rule, it may be said that the rates approach more closely the rates of health the more rigidly responses to effort and emotion are eliminated. It is clear that the excessive rates found in the majority of these subjects are conditioned by exaggerated response to natural stimuli (such as effort and emotion). In investigating heart rate in these subjects, therefore, and especially in using heart rate in prognosis, the utmost care has to be exercised in rendering uniform the conditions under which these rates are studied.

The heart rate is raised in health by exercise ; the degree of rise varying with the amount of work or the rate at which it is accomplished. The rate is high at the end of exercise and falls gradually to normal. The duration of this fall of rate depends upon the character and duration of the work. In the patients, the response to exercise is similar, but it is called forth by much less effort. Thus, if 20-lb. bells are lifted through 6 feet 60 times in 120 seconds by a healthy



young man, the pulse rate immediately after the task is raised to 150 or 160 per minute. In some patients a rise to a similar level may be produced by lifting the bells 10 times in 30 seconds. If, in carefully regulated tests, patient and control submit to work which in each produces the same degree of respiratory distress (the patient doing, therefore, far less work than the control), the height to which the pulse rate rises is the same in the average.

The slow return of pulse rate in these cases is a notable and valuable sign. It is elicited by a test exercise. In healthy men of military age a brisk walk up 40 steps raises the pulse rate in the average some 20 or 30 beats per minute. The rate falls again to normal in a minute or less. In mild cases of the "effort syndrome," the rise is greater (to 120 or 130 per minute), though the fall may still occur in a relatively short time. In the severer cases the pulse may reach 150-180 per minute and in these it returns slowly to normal; the fall exceeds 2 minutes in its duration. As a general rule it may be said that the exercise tolerance of patients who show at a first examination these exaggerated reactions of pulse rate to exercise proves poor, though there are occasional exceptions. When the pulse rate is relatively low and when it returns quickly to normal after rising, the exercise tolerance usually proves good or fair; but to this rule there are frequent exceptions. In men over 40 a pulse rate raised abnormally by exercise is of greater value, a pulse which maintains normal rates is of far less value, than is the corresponding sign in the young.

Pulse rate as a guide to capacity is to be used circumspectly, and the rates obtained from several sources should be compared if they are available. Thus, those obtained on test exercises may be compared with ward rates, and with rates noted as patients return from drills. It is only by using the pulse rate in a broad way that satisfaction



is to be obtained from it. Soldier patients are known to adopt numerous expedients to raise the pulse rate, the most frequent being exercise which is unobserved by the medical officer (see page 93). Drugging in soldiers under our charge, I believe to have been quite rare.

In the patients especially, but also in perfectly healthy men, emotion raises the pulse very easily, a persistent rate of 120 or even 140 during a single and brief examination has very little significance. In the "effort syndrome," the pulse shows an exaggerated reaction to posture.

In pure early mitral stenosis and early aortic disease the pulse rate is not raised naturally, but in these diseases the "effort syndrome" is often superadded. In advanced disease of the mitral and aortic valves, a raised pulse rate is the rule; a raised pulse rate is also conspicuous in infective endocarditis.

#### *Blood pressure.*

The blood pressure (systolic and diastolic) in the patients at rest is rarely more or less than normal. Exceptionally, patients are discovered in whom there is high systolic pressure (160 to 180) at rest. Relatively high systolic pressures are frequent if the patients are examined while up and about. The relatively high readings are due, as are high pulse readings for the most part, to the exaggerated response to exercise or emotion. If test exercises are employed in normal subjects and the blood pressures are taken immediately afterwards in consecutive readings, the blood pressure, at first low, is found to rise steeply to a maximum (half to one minute after cessation of work) and then to fall gradually. The height of the maximal reading is affected chiefly by the amount of work accomplished; it is also affected, though less constantly, by the rate at which the work is done. Similar reactions are discovered in the patients, but the height of pressure reached with a given amount of work is much greater



in them. Thus, to exemplify, in three controls the lifting of 20-lb. bells through 6 feet 30 times in 60 seconds raised the blood pressure to an average maximal of 138 mm. Hg. (an average rise of only 19 mm. Hg.); in two patients submitted to the same test the average maximal pressure reached was 171 mm. Hg. (an average rise of 48 mm. Hg.). The facility with which the blood pressure rises in these patients is such as to render isolated observations upon systolic blood pressure unreliable. Such readings cannot be legitimately used. I have known the systolic pressure to rise from normal in patients of this kind to 180 or 200 mm. Hg. in the ascent of a flight of 40 steps.

The rise of pressure is also prolonged in patients, though not so markedly as is the case with the pulse. If patient and control undertake an amount of work which in each produces the same degree of respiratory distress (the patient therefore doing less work), then the pressure reached and the amount of the rise is the same in the average for patient and control. The reaction to posture is described in another place (page 19).

A *persistently* raised systolic blood pressure at rest is in general a sign of ill-health; a pressure of 160 in the twenties or of 180 in the thirties and forties is usually, but not always, associated with renal disease. In free aortic regurgitation the systolic pressure may be raised to these levels also, the diastolic pressure being lowered; in the same cases the systolic pressure is observed to be much higher in the popliteal artery than in the brachial while the patient lies horizontally (Hill). Aortic stenosis has the reverse effect, tending to bring systolic and diastolic readings nearer together.

To sum up the symptoms and signs found in patients who have no sign of structural disease, we may say that they are the symptoms and signs which appear in a healthy man who submits himself to strenuous exercise. Speaking broadly, it may be said that all the symptoms of these patients



and the changes in the heart rate and blood pressure are symptoms and signs which appear in health in special circumstances of activity. The degree of effort needed to call them forth is an inverse measure of morbidity. It is because these symptoms and signs are largely, in some cases wholly, the exaggerated physiological responses to exercise ; it is because the changes in the reaction of the urine following exercise are the same as in health (Dimond) but are brought out by smaller amounts of work accomplished ; it is because there are these and similar correlations\* that I term the whole the "effort syndrome."

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\* Mrs. Briscoe finds that the capillary leucocytes are increased in these patients ; they are especially increased after exercise ; an increase is also found in health after exercise but by no means to the same degree.

## CHAPTER III.

### ETIOLOGY OF THE "EFFORT SYNDROME" AND OF HEART DISEASE IN SOLDIERS.

#### *Occupation before enlistment.*

Of soldiers who suffer from the "effort syndrome" no less than 57 per cent. have been recruited from sedentary or light occupations. Sedentary occupations include such men as clerks, shop assistants, attendants, printers, teachers, students, etc.; light occupations include waiters, stewards, painters, etc. Clerks alone number 15 per cent. of the whole. From moderately heavy employments (carpenters, fitters, carmen, electricians, etc.) 20 per cent. have been recruited; and from heavy employments, such as professional soldiers, general and farm labourers, miners, smiths, etc., 23 per cent. have been recruited. Thus, the incidence is remarkably heavy amongst men engaged in indoor and sedentary work before the outbreak of war. This fact may be accounted for in one of several ways. A large percentage of the patients was affected by the condition in civil life many years before joining the Army; of these, many had been forced to adopt sedentary occupations and had given up heavier work earlier in life because of their unfitness to do it. Of this class many show defective development; in some the chest is long and narrow, or flattened and associated with a kyphotic curve; in others there is general under-development;



nervousness, with or without definite familiar stigmata, is frequent. The "effort syndrome" is common amongst civilians, often precluding heavy work; usually it does not preclude sedentary work or light work; affected civilians, therefore, tend to drift into these employments, and once they are so employed they are able to carry on with some slight degree of discomfort or they may be entirely free from symptoms. A history of each kind is common. Thus the men frequently relate that they were well once sedentary work was adopted, but were unable to engage in outdoor games or exercises. But it is equally clear that a more considerable number entered sedentary occupations for other reasons. Of these, some became aware that they were unfit for violent exercise at a later date, others had never so tested themselves, and the symptoms of these often date from the earliest days of training. It is unquestionable that many men recruited from sedentary occupations were affected by the condition before joining, although previous to that event in their life-history symptoms had never manifested themselves. The question naturally arises as to the extent to which sedentary work predisposes to the affection; no conclusive answer can be returned from the data at our disposal, though these strongly suggest sedentary work as a predisposing cause. The incidence of infective disease amongst clerks is heavy. To what extent training may rid men of a predisposition to, or early manifestations of, the condition is equally uncertain; training well tolerated increases the reserve. In those who have exercised little the reserve is reduced. Not a few patients have related that symptoms, previously experienced, disappeared early in training to return later on active service; but the number of men who enjoy a similar early experience and endure active service without recurrence of the symptoms is unknown.



It is certain that a large number of recruits were passed as fit in the early stages of the war who were unfit and unlikely to be fit for service ; a history of repeated efforts to join, at first abortive but eventually successful, is common amongst the patients.

TABLE III.

*Occupation before enlistment, expressed in percentage figures.*

	" Effort syndrome " (543 soldiers)	Heart disease (92 soldiers)	Gun-shot wounds. (100 soldiers)
Sedentary or light	57*	42	31
Moderate	20	22	40
Heavy	23	36	29

\* Made up of clerks (15%), salesmen and other sedentary workers (12%), printers, painters and other light workers (30%).

A similar though less conspicuous distribution is to be noticed amongst soldiers invalided for disease of the heart. The high percentage of those formerly employed in light work is to be ascribed, as it is in part in the "effort syndrome" group, to unfitness for heavier work before the men became soldiers. The heavier occupations do not show a higher percentage when related to aortic disease than when related to mitral stenosis ; the fact harmonises with the rheumatic origin of the majority of aortic cases in the Army.

#### *Heart strain.*

A belief that the healthy heart may suffer strain through severe or prolonged exertion has been prevalent, but is not so fashionable as formerly. The conception, always misty, assumes that the healthy organ suffers damage when called upon to force more blood into the somatic muscles.



The chief sources of extra work for the heart in exercise are an accelerated heart action and a rise of mean blood pressure; both of these phenomena are a part of the physiological circulatory response to the call. It is the regulating mechanism of the heart which increases the rate of that organ's beating. It is the heart, in greater part at all events, which raises the arterial blood pressure by an increase of its own output. The circulatory organs are built to stand the strains which they themselves create; their reserve is often under-estimated; it is the full supply of blood to the muscles which will fail, and not the heart, when the call is excessive. How comes it that in the horse, the most heavily strained beast of burden, chronic heart affections are almost unknown? *A priori* the hypothesis of heart strain is not reasonable. It is linked to the old tradition, that the first and last cause of heart failure is a mechanical defect; that tradition is already moribund.

As the hypothesis of heart strain has been applied to the soldier the actual evidence is all against it. The "effort syndrome" has been ascribed to heart strain; the tight tunic, the belt, the shoulder strap, the pack, the long marches have in turn been called to account. The belief in cardiac strain was held more easily in the days when soldiers walked scores or hundreds of miles in the absence of quicker modes of transit. The physical strain imposed upon field troops in this war has been less than it has ever been in a great campaign before, yet the "effort syndrome" is as prevalent as it was, if not more so. It is present amongst troops in training as often as amongst those on front line duty; nay, further, it develops in many civilians to whom strenuous exercise is and always has been unknown. So occasional is the soldier who positively dates the first onset of his symptoms in these days to an unusual strain, that this factor, as primal cause, recedes far into the background. Such a history was



obtained in 5 out of 558 histories. If a soldier lifts a heavy shell and is from that moment breathless—is this breathlessness to be ascribed to the act? He has lifted these shells many times before without trouble. If the respiratory reserve of a soldier is declining gradually, or has declined, it is not surprising that his first distress should come at a moment of exertion; that is the occasion on which his reserve is put to the test and is found wanting. The only form of history in which strain can be admitted as a probable or possible primary cause is one in which the onset of symptoms occurs in a perfectly healthy man at a moment of unusual effort, the symptoms persisting from that time even though he is afterwards engaged in lighter work. Such a history is extremely rare. The chief part which effort plays is clear, it calls upon a waning reserve, aggravating pre-existing breathlessness, or bringing a dormant defect to light. It is said that athletes strain their hearts; especially is this said of those who row in boat races. But it would appear that those who row in boat races are not short-lived, neither do they die of heart affections more frequently than do other men. In boat racers, as in soldiers, the idea of heart strain has found support in the diffuse impulse; a diffuse impulse being regarded as a sign of dilatation. We know now that this sign is untrustworthy. We know, moreover, that the heart's size is smaller after exercise than it is before. Clear evidence as to the size of the heart *during* exercise is not forthcoming; such evidence as we possess for the human subject would suggest that there is no dilatation or that such dilatation as may occur is trivial. According to physiological teaching the heart does dilate when an extra call is made upon it to increase its work (Starling). If this increase in size actually occurs in men while exercising, then it is physiological. Injurious dilatation is safeguarded by the fibrous pericardium, beyond



the capacity of which the heart cannot dilate in health. The heart may be acutely distended, till it reaches the pericardium by inspiring strongly with the glottis closed; that is an experiment which may be performed time and again with impunity by healthy men. In paroxysmal tachycardia the heart sometimes dilates greatly; when the paroxysm ceases, the organ shrinks to its original size, and the subject of the paroxysm is none the worse for it. Here is an instance in which a pulse rate of perhaps 200 per minute is maintained night and day for fourteen days; the heart dilates and the patient becomes cyanotic and his liver swells. Yet, when the paroxysm ends, the capacity of the man for work is precisely what it was before the paroxysm began. The most direct evidence is obtained from soldiers suffering from the "effort syndrome"; examined at the cessation of strenuous exercise, the heart is of the same size as it was before the exercise, or is actually smaller. The average measurement of the heart in these cases before and after exercise is actually less than it is in a similar series of healthy people (Meakins).

Neither in civilian nor in military practice have I seen a patient in whom I could regard the evidence for heart strain as a primary cause of breathlessness as at all convincing; yet I have been shown many patients purporting to be instances of such strain. In cases of so-called acute dilatation of the heart, which I have been called to see and in whom I could find dilatation, the basal condition has always been an unrecognised paroxysm of tachycardia.

Of the thousands of patients we have drilled, a few score have fainted while at work, a larger number has fallen out exhausted; not a single man examined has shown dilatation of the heart either at the time or afterwards; not one has been the worse for his experience.



If strain of the healthy heart exists it is no more than a curiosity.

*Infection.*

The dominant etiological factor in the clinical histories of soldiers complaining of the "effort syndrome" is infection of one kind or another.

TABLE IV.  
*Cause of onset. (Year 1914-1915.)*

Symptoms date from	"Effort syndrome"	Heart disease
Gradual onset .. ..	314 (56%)	52 (51%)
Rheumatic fever or chorea	68 (12%)	25 (25%)
P.U.O. or influenza .. ..	28 (5%)	1 (1%)
Dysentery .. ..	17 (3%)	1 (1%)
Pleurisy and bronchitis ..	15 (3%)	0 (0%)
Pneumonia .. ..	10 (2%)	2 (2%)
Diarrhoea .. ..	10 (2%)	0 (0%)
Enteric fever .. ..	6 (1%)	1 (1%)
Other infectious diseases ..	27 (5%)	7 (7%)
	33%	37%
Wounds and accidents ..	19 (3%)	6 (6%)
Gassing .. ..	14 (2%)	2 (2%)
Shell-shock .. ..	13 (2%)	2 (2%)
Under bombardment ..	9 (2%)	0 (0%)
Sudden strain .. ..	5 (1%)	0 (0%)
Frost-bite and inoculation ..	3 (1%)	2 (2%)
	11%	12%
Total .. ..	558	101

Thus amongst 558 patients, the symptoms dated from an infectious disease in no less than 181, or 32 per cent. Rheumatic fever, standing actually at 12 per cent., easily occupies the first place, pyrexia of unknown origin or influenza occupies the second place and dysentery comes third. But the full 32 per cent. is by no means exhaustive; thus, amongst the 377 patients who remain there is a history of rheumatic fever occurring either some while before the onset, but not directly connected with it, or more rarely, months or years after the onset of symptoms, in 57 cases; there is a similar history of repeated joint pains or chorea in 8. Thus 65 of these patients belonged definitely to the rheumatic



class, although the precise significance of rheumatism in relation to the malady is in many uncertain. Of the remaining 311 patients, a further considerable proportion had suffered prior to the onset of symptoms from pneumonia, pleurisy, bronchitis, dysentery and other infectious diseases; a history of repeated tonsillitis is frequent amongst them. In at least 50 to 60 per cent. infectious diseases may be held to play a chief part in promoting the syndrome in its initial stages. In a few cases a chronic infection has appeared to be the sole and continuously underlying cause; for after the successful treatment of dysentery or chronic appendicitis the symptoms have vanished.

TABLE V.  
*Prevalence of infectious diseases, etc. (Year 1914-1915.)*

	" Effort syndrome " (558 soldiers)	Heart disease (101 soldiers)	Gun-shot wounds (100 soldiers)
No past illness or accident	99 (18%)	11 (11%)	82 (82%)
Rheumatic fever or chorea	127 (23%)	62 (61%)	4 (4%)
P.U.O. or influenza ..	69 (12%)	6 (6%)	0 (0%)
Enteric or enteritis ..	43 (8%)	1 (1%)	4 (4%)
Wounds or accidents ..	37 (7%)	10 (10%)	—
Dysentery .. ..	33 (6%)	3 (3%)	2 (2%)
Pneumonia .. ..	34 (6%)	10 (10%)	3 (3%)
Scarlet fever .. ..	26 (5%)	1 (1%)	1 (1%)
Shell-shock .. ..	22 (4%)	5 (5%)	0 (0%)
Gassing .. ..	17 (3%)	2 (2%)	0 (0%)
Bronchitis .. ..	19 (3%)	0 (0%)	4 (4%)
Tonsillitis .. ..	45 (8%)	6 (6%)	0 (0%)
Malaria .. ..	15 (3%)	0 (0%)	6 (6%)
Venereal disease ..	13 (2%)	4 (4%)	5 (5%)
Pleurisy .. ..	16 (3%)	1 (1%)	3 (3%)
Trench fever .. ..	5 (1%)	0 (0%)	0 (0%)
Trench feet .. ..	9 (2%)	3 (3%)	0 (0%)
Other illnesses .. ..	87 (16%)	5 (5%)	0 (0%)

The analysis has been carried out in each group upon similar lines. Any infection which has kept the subject of it more than two or three days in bed is entered in the table, excepting such painful ailments as muscular rheumatism, lumbago or sciatica. I include quinsy, and also repeated or severe tonsillitis. I exclude any uncomplicated exanthema which occurs before the age of 10 years. In the table, incidents such as shell-shock, gassing and wounds are also included. If a patient has suffered from the same malady or accident on two occasions, this illness is included once only in the construction of the table, so that its statement may be simplified.



In stressing the high incidence of infectious diseases a further analysis may be undertaken; it is a comparison of the frequency of serious illness amongst "effort syndrome" cases and in those of gun-shot wound. Amongst 558 patients of the "effort syndrome" group, not much less than 80 per cent. had suffered from an illness which might be regarded as serious. In the 100 men suffering from gun-shot wounds, men of similar ages and invalided after equal or longer periods of service, the incidence was but 18 per cent.

The history of the onset of symptoms at the time of an infectious disease is about as frequent in sufferers from the "effort syndrome" as it is in soldiers who have heart disease (*i.e.*, 33 per cent. and 37 per cent., respectively), see Table IV; the incidence of illnesses generally is also not dissimilar in these two groups (approximately 80 per cent. of the histories show it in both groups); see Table V. Thus there is a close similarity between the two groups in respect of their past liability to infections; the chief difference is found in the types of infection. In the "effort syndrome" group, the total incidence of rheumatic fever and chorea is 23 per cent., in the heart disease group it is 61 per cent.; in men invalided for gun-shot wounds (the controls) it is 4 per cent.; the onset of symptoms is dated from rheumatic fever in 12 per cent. of the "effort syndrome" group, and in 25 per cent. of the heart disease group. The infectious illnesses, to which cases of the former class have been specially prone in contradistinction to those of the heart cases, are:—pyrexia of unknown origin, enteric fever, dysentery, scarlet fever and malaria.

The figure 61 per cent. for the incidence of rheumatic fever (or chorea) in heart disease in soldiers, although high as compared to the figure for the civilian populace, is the proper figure to accept in comparing the influence of rheumatic fever in the two groups; for the comparison is between classes of men of similar age and in similar environments.



In soldiers who have already acquired the "effort syndrome," serious infections almost always, and mild infections often, increase the severity of symptoms. It is not possible fully to present the incidence of infection as an aggravating cause, but it may be illustrated by the statement that of the large group of 314 patients in whom the immediate cause of onset remains uncertain, at least 50 were first invalided to hospital for infectious diseases which were found, during convalescence from the intercurrent illness, to have aggravated the symptoms; an even larger number gave histories of similar infections aggravating the symptoms at more remote periods. In the wards of our hospitals an attack of tonsillitis, influenza, or similar infection is almost always followed by a conspicuous set-back of exercise tolerance and an exaggeration of symptoms and signs. This was notably the case during the recent sore-throat ("influenza") epidemic.

The relation of infections to the cases of real heart disease must also be emphasized; it is of first importance. That mitral stenosis or aortic disease are usually due to inflammatory processes of infective origin is almost universally taught. But the close relation of the events of the subsequent history to infectious processes is not as widely recognised. Nothing jeopardises the condition of heart patients more than infection, be the infection rheumatic fever or an infection expressed as tonsillitis, influenza, bronchitis, or what not. In civilians as in soldiers, careful questioning and observation show that this factor is of greater consequence than strain. Obvious infections are the frequent predecessors of exaggerated symptoms or of an increase in the gravity of the valve lesion; they are frequently responsible for that breakdown of the muscle which portrays itself in symptoms and signs of failure. During the recent "influenza" epidemic, the infection spread to a ward reserved for cases



of serious heart disease; we lost two patients, and the lives of several others were seriously jeopardised. It is remarkable how many instances of heart failure are admitted to hospital in a febrile state; it is remarkable how often a rise of temperature in a bed case formerly afebrile foreshadows a temporary or permanent change for the worse. Diffuse but chronically active inflammatory lesions are to be found in a large proportion of hearts which have dilated and failed. When it is thoroughly grasped that infection has more to do with heart failure than has strain or a mechanical defect in the heart itself, at all stages of the disease, in its initiation, in its development and in its progress to immediate circulatory embarrassment and death, then and only then is the natural history of heart disease understood. Bodily strains and mechanical defects, an increase in the rate of ventricular action, such as auricular fibrillation\* engenders, undoubtedly burden the heart with extra work and play their part, but they are not the dominant factors. The dominant factor is invasion of the heart by infective organisms or their products and a consequent weakening of the myocardium. This view of cardiac failure I cannot too strongly emphasize at the present time, for it is especially to relatively young patients, in whom degenerative processes of the heart (the outcome of coronary disease) are comparatively rare, that it is applicable. It throws a new light on many of the phenomena witnessed; it permits us to explain those frequent instances of enlarged heart in which no mechanical defect or increased burden is to be discovered.

I put forward the following postulates, recommending them as the basis of a working hypothesis.

1. *The burdens imposed by physiological acts upon the heart, however heavy these burdens may be, never exhaust the*

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\* For which seemingly infection is often directly responsible.



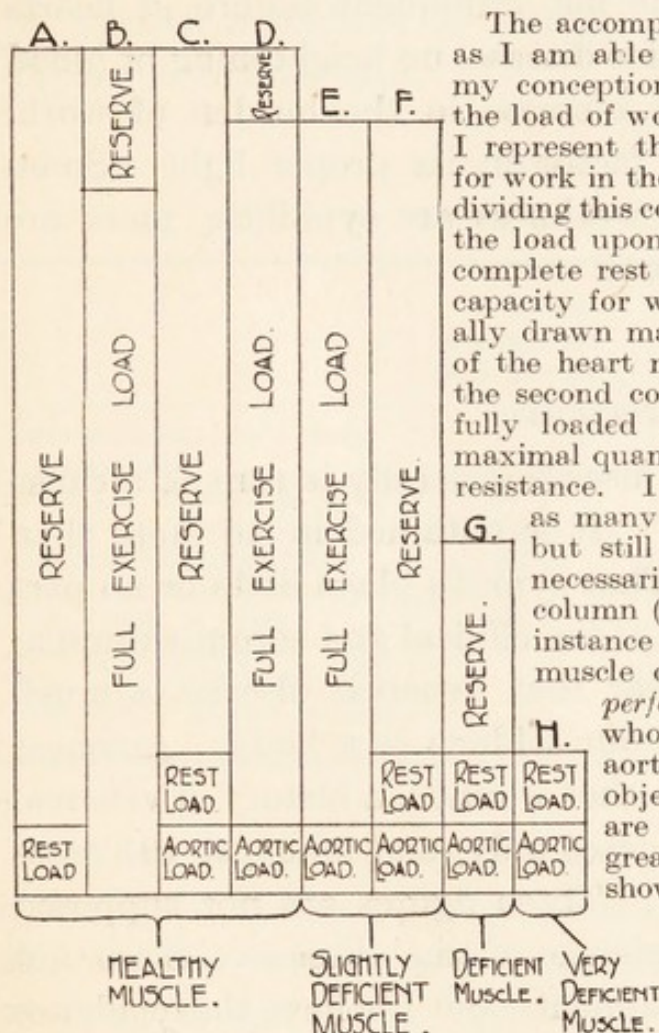
*heart's reserve.* The reserve of other bodily structures will fail before the heart is pushed to its limits of endurance.

2. *The extra burden of work thrown upon the heart by an aortic or mitral insufficiency, the extra burden thrown upon the right heart by a mitral stenosis (other than extreme stenosis) or upon the left heart by an aortic stenosis (other than extreme stenosis), the extra burden thrown upon the left heart by continuously raised blood pressure, would never by itself be sufficient to produce embarrassment of a healthy muscle while the body is at rest.* That they impose a burden I do not question, that this burden reduces the reserve which the heart possesses to meet the full physiological needs is also fully granted (see diagram and remarks upon it). But that one or other of these burdens is in itself sufficient to eat up the whole reserve of the heart of the resting man is, at the very least, open to the most serious doubt. The reserve power of the resting heart is enormous. These lesions are not in themselves lethal—the man is killed by the coincident weakening of the heart muscle. Maybe the weakened muscle is overburdened by a valve defect; but the heart will fail in many patients when no such burdens are discoverable. The development of cardiac failure with congestion in congenital lesions of the heart, lesions such as pulmonary stenosis, which often impose greater burdens than do the inflammatory lesions considered, is rare. That is so because the valvular defect is uncomplicated, the muscle is clean and healthy.

3. *The hearts of patients upon whom these burdens of valvular disease are thrown fail because the heart muscle is unhealthy.* It has been rendered unhealthy by the same processes which injured the valves, or by interferences with the coronary circulation.



On the basis of these postulates we can explain why this heart dilates to the strain of a paroxysm of tachycardia, while that heart does not. We can interpret the failure of



The accompanying diagram expresses, so far as I am able to express it diagrammatically, my conception of heart failure in relation to the load of work which the heart has to bear. I represent the capacity of the normal heart for work in the first column (A) of the diagram, dividing this column into two parts, to represent the load upon the heart while the body is at complete rest (*rest load*) and the *reserve*. The capacity for work in reserve I have intentionally drawn many times greater than the work of the heart muscle in conditions of rest. In the second column (B), I represent the heart fully loaded by exercise, putting forth the maximal quantity of blood against an increased resistance. I represent this *full exercise load* as many times greater than the *rest load*, but still show a reserve, though this is necessarily much diminished. In the third column (C) is represented a hypothetical instance of aortic reflux in which the muscle of the heart is supposed to be *perfectly healthy*, and I subdivide the whole column into the rest load, the aortic load, and the reserve. My objects in introducing this column are to represent the aortic load as no greater than the rest load and to show the reserve as little diminished.

The reserve is still capable of absorbing the full exercise load without being itself completely exhausted (a condition represented in column D). Column D represents an ideal case, to which, however, certain instances of aortic reflux in soldiers closely approach, for the patients to whom I refer present an almost perfect exercise tolerance. Columns E and F represent these patients more truly, for in such aortic cases there is probably always some deficiency of the muscle; I represent the reserve as just exhausted by the full exercise load (column E), but as ample for all the usual calls of every-day life (column F). In column G I represent the heart muscle as definitely deficient, the rest load and aortic load together occupying a considerable proportion of the whole column, and the reserve as greatly diminished as compared to the normal. Such a heart is incapable of meeting anything but small demands for increased work. Lastly, in column H, a heart is represented in which the muscle is very deficient and in which the rest load and aortic load are all that the heart is capable of carrying. Such a heart is just capable of maintaining the circulation when the body is at complete rest, but it is capable of no more.

The object of the whole diagram is to stress the view that the heart fails, not so much because the load upon it is increased, but because its reserve is exhausted by damage of its muscle; that is my working hypothesis.



this heart in which the mitral valve is stenosed, the absence of failure in that heart in which equal or greater stenosis has been present for an equal or longer period. These postulates will explain the not infrequent failure of hearts in which there is no valvular disease, no heightening of blood pressure or other evident increase in the burden of work. It places the myocardial factor in its proper light. Some such cases of myocardial weakness are syphilitic, more are of rheumatic origin in young men.

### *Syphilis.*

A history of venereal disease generally is rare as a cause of the "effort syndrome." It is obtained in no more than 2 per cent. of the cases. That syphilis plays little or no part in the condition is clear from the clinical and serum examinations; but it is not so clear that venereal disease is much rarer in these men than in our soldiers as a body. Amongst 100 men suffering from gun-shot wounds, a history of venereal disease was obtained in 5 cases only, and amongst 101 cases of heart disease in 4 only. These figures are not supposed to represent the full incidence of the diseases—there are special reasons for its concealment—but I believe the incidence to be comparatively rare and that its prevalence in the new armies has been exaggerated in some quarters. Of our purely aortic cases, 66 have been submitted to the "complement fixation" test (in triplicate); only 8 cases gave positive reactions. These last were for the most part men over 40 years of age.

Syphilis plays but a small part in the production of aortic disease in the present armies; it plays a relatively small part for precisely the same reason that rheumatic fever plays a large part, namely, because of the youthfulness of the soldiers.



*Influence of tobacco.*

The consumption of tobacco by patients who complain of the "effort syndrome" as compared with the consumption by wounded soldiers is small; its consumption in heart disease is smaller still.

TABLE VI.

*Tobacco consumption.*

	"Effort syndrome" (461 soldiers)	Heart disease (87 soldiers)	Gun-shot wounds (100 soldiers)
Non-smokers, or very occasional .. ..	6%	13%	2%
About 2 cigarettes daily, or 1 oz. a week ..	20%	22%	3%
About 5 cigarettes daily ..	42%	40%	23%
About 10 cigarettes daily, or 3 ozs. a week ..	27%	22%	49%
About 20 cigarettes daily, Over 25 cigarettes daily,	4%	1%	21%
or about 10 ozs. weekly	1%	2%	2%

That tobacco is a chief cause of the "effort syndrome" is disproved by these observations and by the knowledge that the condition is frequent in Sikh soldiers (Macgregor), to whom smoking is forbidden. But that smoking aggravates the symptoms is not to be gainsaid; many patients confess consciousness of this fact. The small consumption of tobacco in heart disease is attributable to the increase of symptoms which the drug produces. Tobacco smoking is widely admitted to shorten a man's "wind."

The reaction of the pulse rate to exercise is increased by smoking in cases of the "effort syndrome" (Parkinson). The heaviest smokers are nevertheless the men in whom exercise tolerance is in general the greatest; the reason being that the men who have the malady in mild degree are relatively undisturbed by tobacco.



*Consumption of alcohol.*

Fifty-three per cent. of cases of the "effort syndrome" group are teetotallers, as compared to 33 per cent. of gun-shot wound group. The consumption of alcohol amongst the

TABLE VII.  
*Alcohol consumption.*

	"Effort syndrome" (454 soldiers)	Heart disease (83 soldiers)	Gun-shot wounds (101 soldiers)
Teetotallers .. ..	53%	43%	33%
Occasional drinks ..	12%	17%	20%
One pint of beer or less daily .. ..	15%	22%	25%
Two or three pints daily ..	18%	11%	14%
Over three pints daily ..	2%	7%	8%

men of the first group is small; instances of men returning to hospital the worse for drink are rare, though they leave the hospital grounds freely in the afternoons. The severe cases drink less alcohol than the mild cases. The usual reasons assigned for abstinence are purely conscientious, some have no inclination; in a few alcohol aggravates the symptoms.

Amongst cases of heart disease the consumption of alcohol is intermediate between the "effort syndrome" and gun-shot wound groups.

*"Hyperthyroidism."*

In patients admitted to hospital under the diagnosis of "D.A.H.," or "V.D.H.," symptoms and signs sufficient to warrant a diagnosis of Graves' disease are extremely rare. A few such patients we have seen; a very few patients have developed ocular signs while in hospital. There is no justification for the not uncommon belief that every patient who has an enlarged thyroid and tachycardia is an incipient



case of Graves' disease or is suffering from excessive activity of the thyroid gland ("hyperthyroidism"). Certain writers, imbued with recent endocrinological doctrines, are but too ready to regard every enlarged thyroid as an over-acting gland; these writers seem unaware how frequent a palpable thyroid is present in soldiers and civilians who suffer from no symptoms. The hypothesis of "hyperthyroidism" is not only premature, but careless in its application. It is not even proved that Graves' disease is the result of excessive thyroid secretion. To adopt "hyperthyroidism" as the primary cause of his complaints in a patient who presents the "effort syndrome" and a palpable or obviously enlarged thyroid, without further investigation, is to succumb to a line of reasoning fraught with elementary fallacies. Tachycardia, tremor and loss of flesh are common manifestations of many prevalent forms of ill-health; in dealing with the class of patients whom we have under consideration the presence of these symptoms is practically valueless in diagnosing exophthalmic goitre. The actual prevalence of clinical enlargement of the thyroid in those of our patients who present the signs of heart disease is, I believe, little or no greater than in soldiers returned for medical ailments to other hospitals. Amongst 517 cases of the "effort syndrome," the clinical condition of the thyroid was as follows:—

TABLE VIII.  
*Thyroid enlargement.*

No enlargement	..	..	..	..	483 cases
Generally enlarged	..	..	..	..	5 "
Slightly enlarged	..	..	..	..	4 "
One lobe enlarged	..	..	..	..	1 "
One lobe slightly enlarged	..	..	..	..	3 "
Isthmus enlarged	..	..	..	..	1 "
Isthmus slightly enlarged	..	..	..	..	5 "
Enlargement doubtful	..	..	..	..	15 "

Thus palpable enlargement (uniform or local) was ascertained in 19 out of 502 soldiers examined, or in 4 per cent..



Of these 19 patients, only 1 showed undue prominence of the eyeballs, and in him other ocular signs suggestive of Graves' disease were associated. The heart rate in patients with thyroid enlargement is in the average no greater than in those who have none, and enlargement is as frequent amongst those returned to duty as amongst those discharged permanently unfit. To ascribe the symptoms to the thyroid gland, without fully taking into account the relative prevalence of parenchymatous and adenomatous enlargement, as opposed to the enlargement of Graves' disease, is to walk blindfold into a pitfall. The frequency of unilateral or local enlargement, the lack of the thyroid thrill, should in themselves form sufficient warnings. When a test has been devised which will measure the amount of thyroid secretion in the blood, and when in cases of suspected "hyperthyroidism" the blood content of this substance is shown to be excessive, then this conception will be more justified.\* The application of X-rays to the thyroid has been recommended and employed in cases of the "effort syndrome" and reports of benefit have been published. We find these reports quite unconvincing; they are based seemingly on casual observations upon pulse rate. The most direct test of which the hypothesis is at present capable is an estimate of the thyroid tolerance of our patients. Very many observations have been conducted from this point of view; the results show the patients to be not unusually intolerant of the gland extract.

#### *Gas poisoning.*

In 1915 a history of the "effort syndrome" ascribed to gas poisoning occurred in 14 out of 558 men (3 per cent.). If a soldier who has symptoms is "gassed," his symptoms are

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\* A precisely similar remark is applicable to the conception of "hyperadrenalism," which as an hypothesis has also found some favour.



usually increased. In a considerable proportion of the cases in which "gassing" has occurred, and is emphasized in the man's history, questioning makes it clear that the malady antedated the gas poisoning. Drift gas is stated to have been more potent than "mustard" gas in producing the syndrome. In routine admissions to our home hospital, the "gas" factor appears to be relatively unimportant, but that it may be more than an aggravating cause seems clear from recent reports. Pryce Jones and Hunt had a large number of "gassed" men under observation, and the symptoms developed in more than 30 per cent. of them. There is a good deal of evidence to show that in men who are healthy at the time of "gassing," but who develop symptoms afterwards, these symptoms are relatively transient. Those patients who ascribe their first symptoms to "gassing" form a favourable group. In our routine admissions, the incident "gassing" figures about as frequently amongst the cases of heart disease as amongst those who present no signs of structural lesion, both as regards the incident from which the onset is dated and as a cause of aggravation of the symptoms. Gas poisoning is related by patients as the primary cause of trouble in cases of mitral stenosis and in aortic disease, though it can produce neither. The chief importance of these last histories is the clear lesson they convey. If this assignment of cause is inadmissible in the real heart case, it is also inadmissible in many cases of the "effort syndrome."

#### *Shock.*

In 13 instances out of 558 cases of the "effort syndrome" (or 2 per cent.) the onset of symptoms dated from shell-shock or mine explosion; but in 2 of these cases duty was carried on until an infection sufficiently aggravated the symptoms to warrant invaliding. Considering the number of soldiers who have been exposed to shock from shell explosions, instances



of its onset from this event in an unselected series are remarkably small in number. If of a large number of men, similarly exposed, only a few develop symptoms subsequently, it is to be concluded that in those who suffer there was already a predisposition. Immediately after the event a history of preceding symptoms is rarely to be obtained from men invalided for shell-shock; the incident figures too prominently in their minds; but at a later date such a history may often be elicited. Such had been the case in 9 additional patients of this series. When, on account of minor symptoms, men are hard put to it to fulfil their duties, where there is a struggle between the sense of duty and consciousness of a certain grade of unfitness, the consequences of shell-shock are not difficult to understand. Shell-shock is clearly but an aggravating cause almost as often as it is suspected to be the provoking cause. It is probable that it is never more than an aggravating cause.

A history of shell-shock as the first cause of symptoms is obtained with equal frequency in heart disease (2 per cent.) and amongst these are examples of mitral stenosis. In such cases we must choose between alternatives. Either the symptoms (the usual symptoms of early mitral stenosis before the onset of stasis and symptoms which closely resemble those of the cases in which no structural lesions are detected) were produced by shock or they were not; in the first alternative we may not ascribe them to the valve lesion, in the second we must doubt the accuracy of the history. In both attitudes we may conceivably be justified; one or both represents the facts of the case. That the histories were given in good faith we do not doubt; that symptoms were previously present, that they passed unheeded, or that the memory of them was obliterated by the major event in the military history, seems to us probable. But, clearly, if these arguments are admissible in cases of mitral stenosis,



they are also admissible when similar symptoms follow shock in cases where there is no mitral stenosis. Such instances of grave heart lesion in which the symptoms begin after shock cannot avoid consideration when the influence of shock upon the symptoms of the "effort syndrome" group is gauged. Shell-shock figures equally as a cause which aggravates symptoms in the two groups of cases.

*Associated derangements of the nervous system.*

In a group of men, many of whom have presented since early life a deficiency of physical strength, and a goodly proportion of whom show signs of faulty or retarded development, apparent weaknesses or actual defects in the nervous system are to be expected. Further, in a group of patients the majority of whom have been exposed to the wear and tear of trench warfare, the majority of whom have suffered from infectious diseases, the nervous system will not often remain entirely exempt; it will suffer especially in those men who are constitutionally weak. So it happens that amongst any large group of patients who suffer from the "effort syndrome" a number is discovered in which nervous manifestations are more or less prominent. That abnormalities of the central nervous system may be in part responsible for the symptoms of the "syndrome" in individual cases seems highly probable. But that the syndrome is produced by a primary defect of the nervous system is not likely. Nevertheless a proportion of the patients whom I include in the group "effort syndrome" sooner or later acquire the diagnosis of *neurasthenia*, from time to time qualified by the phrase "of the vasomotor type"; especially is this so when brisk reflexes are associated with mental irritability or exhaustion. Now the term "neurasthenia" is still undefined or, to be more accurate perhaps, it is over-defined, in the sense that patients of



clearly different types are included under this designation. The diagnosis brings with it no appreciable insight into pathology, frequently it has the special defect of guarding the patient against further detailed investigation; in many neurological quarters the term is indeed falling into disuse, as it is lacking in exactitude of expression. Yet we cannot afford to overlook or study those aspects of the "effort syndrome" case which sometimes bring to it this diagnosis. The psychology of our patients as a group is not that of the average soldier; a large proportion of the men are of highly-strung nervous temperament, an unusual number are sensitive or querulous, others are apathetic or depressed. An abnormally\* large proportion, as I have pointed out, eschew the use of alcohol for conscientious reasons. Unreasonable phobias are not so common as are minor psychoses, such as fear of the dark, and thoughts which, while fanciful, are recognised as such by the men who experience them. Defects of memory, inability to concentrate, mental confusion at the attempt to concentrate are extremely common. The sexual tendencies and activities are not in the average normal. Exposure to venereal disease is relatively rare; spermatozoa in large numbers are found in the morning urines in 15 per cent. of the patients. Enquiries by Oppenheimer and Rothschild as to the condition in childhood frequently elicited a history of nervousness, frights, somnambulism, or nocturnal enuresis. The same medical officers, in investigating the family histories, discovered the frequent presence of nervousness, fits and actual insanity. There is always a small group of patients in our wards who are subject to terrifying nightmares; battle dreams predominate amongst these. Reference has already been made to breathlessness which is clearly of nervous origin and to fainting attacks

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\* Abnormally in the sense of diverging from the average.

of a frankly hysterical nature. Anæsthesia is, however, rare. In describing these nervous manifestations I do not wish to be misread. These symptoms do not stand by themselves in our patients ; I regard them as additions. Few of them are, I think, essential parts of the "effort syndrome." Some, such as the lack of power to concentrate, may be, for this symptom at all events is bound up with the general condition of fatigue. They are not present constantly ; most patients do not exhibit them, but they are of sufficient frequency to leaven the group as a whole. It is probable that in part they are due to the same fundamental etiological factors ; in part they are almost certainly developmental or hereditary. Nevertheless in many of our patients the condition of the nervous system, whether it be hereditary or acquired, is such as to exaggerate those complaints which belong properly to the "effort syndrome."



## CHAPTER IV.

THE DIAGNOSIS OF HEART DISEASE IN  
SOLDIERS.*Enlargement of the heart.*

The heart may be enlarged because its cavities are dilated ; it may be enlarged because its muscle is increased in mass (hypertrophy). Much has been written upon these changes in the heart and upon the physical signs which they are supposed to display ; a very large part of these writings rest, not upon observation of new and relevant facts, but upon speculation. Most of us have been educated clinically to differentiate between hypertrophy and dilatation. We have come at some stage of our training to regard this power as a necessary accomplishment ; to experience, where we are unable so to differentiate, a disquieting sense of relative incompetence in ourselves or an admiration for those who profess success ; in some instances consciously to conceal an inability which we regard as an embarrassment. We lack either the opportunity or the inclination, beset as we are by manifold tasks, to pause and weigh the evidence or to test for ourselves the doctrines instilled into us. They are accepted by most of us—pupils all at first—and become a part of our faith ; with many of us they are transformed to unchangeable beliefs.



Upon teachers lies a heavy responsibility ; to teach as dogma that which lacks proof may be excusable in those who, educated in traditional grooves, have acquired faith in their own competence ; to teach the same as dogma while secretly recognising our own inability or while doubting this ability is inexcusable. Reflections of this kind and recent observation force me to state my own failure clearly to differentiate between and assess hypertrophy and dilatation in the living and persistently enlarged heart. The confession, if it be a confession, may at least offer consolation to those who, being in like case, will thus learn that they are not alone. If in a patient under continued observation, the heart signals its enlargement in the space of a few hours or days, in a period short of that which we know to be essential to an actual and material growth of muscle fibre,\* assuredly we may be content that dilatation has occurred. But such a case is not in mind ; it is the case where enlargement is neither of quick growth nor transient, but is apparently a permanent change. Of this I would record the opinion that to assess the comparative degrees of hypertrophy and dilatation is rarely if ever possible.† It is probable that in almost all instances where the heart is permanently enlarged, hypertrophy and dilatation are co-existent ; to estimate the relative degrees of muscular growth and stretching in the living man is not possible, it is moreover unnecessary. Professedly to estimate these factors so nicely as to express from them an opinion of "compensation" is an art which belongs more to the last than to the present century ; to estimate and balance the same factors in a single ventricle is

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\* Experiment goes to show that when a simple mechanical burden is thrown upon the heart, the heart will hypertrophy to its full extent in about thirty days.

† Even at the *sectio cadaveris* it is rarely found to be feasible ; sources of error are very numerous, none more so than the filling of the heart with blood at death and the contraction of the muscle on its contents in the rigor of death.



entirely beyond our reach. Compensation is a term which, used in its introductive sense, implies a balance between the two factors; used in its present-day sense, a sense different from the original, "lost compensation" implies and is synonymous with one form of commencing cardiac failure. Simplicity and clarity of thought are essential in matters clinical; when we speak of lost compensation we *mean* that we observe the signs of impending heart failure, that the venous system is visibly or palpably engorged and that the heart proclaims itself the cause. It may not have occurred to all that as much is conveyed in the more exact expression "failure with congestion"; such an expression does not imply that dilatation has the upper hand of hypertrophy, which implication, strictly speaking, is hypothetical and, in a given case, is not directly within the bounds of our knowledge. But even if it is allowed for purposes of argument that the form of cardiac failure in question results from a disturbed balance between the two factors under discussion, it is to be emphasised that *such a loss of balance is not recognised by assessing and comparing hypertrophy and dilatation but by the supposed effects of the disturbed balance upon the venous contents*. The over-filling of the veins stands out; it is indeed the essential clinical observation and attention is not to be distracted from it for an instant. The diagnosis of venous over-filling of cardiac origin is within the easy reach of all; the diagnosis of "lost compensation," in its old sense, is not within the reach of any of us; the diagnosis of the first serves the same end as the last, it serves it as well, it even serves it better, for it is an uncomplicated expression of what we see and feel. The difficulty of "lost compensation" as a clinical conception may well be illustrated by those cases of paroxysmal tachycardia where, with an excessively rapid heart action, the heart eventually dilates (see page 74). In the end



stages of the attack the heart is dilated (it has greatly enlarged in a few hours or days), the venous system with its tributary liver sinuses is engorged. Compensation, to use the old and still widely current phraseology, is lost ; heart failure with congestion, to use more accurate terms, has set in. Suddenly the heart rate falls precipitately, the normal rate is resumed ; in that moment the heart begins to shrink, in a few moments, or at the most a few hours, it is of normal size, the veins decrease to their normal calibre ; thus the heart failure is relieved ; “ *compensation is restored.* ” Assuredly the relief comes from no compensating hypertrophy in those moments, neither does it come from diminished dilatation ; the relief comes from the fall of heart rate ; a burden is removed ; it is not a restored balance between dilatation and hypertrophy which ends the patient’s suffering, the restored balance is secondary and incidental ; the heart cavities and veins, sharing an engorgement, are together emptied by an increase in the efficient work of the muscle.

Modern physiology, be it remembered, teaches that in circumstances of experiment *the normal heart in meeting extra work will dilate and thereby increase its capacity for work.* In that teaching, coming as it does from an authoritative source, is at least a clear warning that theories of “ compensation ” are not yet on an unassailable basis. Let it also be remembered that a man may be at death’s door from cardiac failure (of the anginal and not the congestion type) when “ compensation ” or its failure is a question which none would raise.

It is sufficient to diagnose enlargement of the heart without attempting to differentiate between hypertrophy and dilatation in chronic heart disease. When the heart is materially enlarged (whatever the cause of such enlargement) the outlook is not propitious ; the man who displays it is unfit to be a soldier ; he is unfit for any but light work.



To estimate correctly the size of the heart in soldiers is of much consequence and it now remains for us briefly to discuss the signs which serve us best in this respect.

*On signs used to recognise enlargement.*

The size of the heart is variable in healthy men; the weight of its muscle is related to the weight of the somatic musculature. The more strongly-built is the man and the better developed is his musculature, the heavier is his heart. In estimating the size of the heart in the living subject, allowance must be made for this purely physiological variation.

Accurately to measure the size of the heart by clinical methods is clearly impossible; all such measurements are but approximate. Many signs are in general use; some of these are more valuable than others.

*The orthodiagraphic method.*—An X-ray picture of the chest taken with the tube behind and the plate resting on the sternum gives a picture of the heart's outline. This outline is not accurate. A candle held in the hand projects an enlarged silhouette of the body upon the wall of the room, the magnification depending upon the distance of the body from the candle and from the wall. The nearer to the wall and the further from the candle is the body, the smaller is the distortion. So with the X-ray tube, the further it is placed from the back and the closer the plate comes to the heart, the more accurately does the shadow represent the size of the heart. But it cannot do so quite accurately, and in plates as they are ordinarily taken the error is large. The distortion is due to the divergence of those rays which, springing from the small kathode, separate as they pass to and beyond the margins of the heart. The *orthodiagraph* is a simple device introduced to obviate this error of measurement. The tube is arranged in a case impermeable to the rays except at one



point, so that only a small beam is allowed to pass through the chest; the tube is freely movable behind the body and the beam is carried around the margin of the heart, the paths of the beam through the body being always strictly parallel. Each time the beam is moved a small section of the heart's outline becomes silhouetted on the screen and is recorded. In this manner, and providing that each section of the outline is recorded in a similar phase of the respiratory and cardiac cycle, an accurate outline of the heart is obtained. The method gives the most exact measure of the heart's size which we possess, but it is still imperfect, for the record shows the outline of the heart in a single plane only. To obtain a complete measure of the heart it would be necessary to record the silhouette in several planes. The record in the coronal plane is, however, in general sufficient, and it may be used to evaluate physical signs which purport to indicate the size of the organ. In our patients this method has been employed by my late colleagues, Major Meakins and Captain Gunson; and it is partly upon their findings that I base the conclusions which follow.

*The maximal impulse.*—The heart's impulse in the healthy chest of young adults is usually, though not always, confined to a small area and is situated in the 5th interspace 3-4½ inches from the middle line.\* It is a distinctly *palpable* impulse; a finger placed upon it clearly feels a pushing movement of the underlying heart muscle; it is not an almost impalpable flicker but a definite and more or less sustained thrust. The area over which this is felt may be

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\* Three-and-a-half inches, the figure usually given, is not elastic enough. The nipple line, also used as a guide, is sound in so far that in large men the nipple is more distant from the sternum; but the nipple has not a constant relation to the outline of the chest wall.

The heart is perhaps most conveniently examined with the patient erect. Sometimes the impulse will move out a little when he lies, more often it will move in. One posture should be used in routine examinations, though in doubtful cases of enlargement it is wise to examine the heart in both.



covered in most men by a shilling piece ; and the outermost limit of this circumscribed area is the best clinical guide which we possess to the left border of the heart and, providing the heart is not displaced, to the size of the organ. It corresponds very accurately with the left limit as depicted by the orthodiagraphic shadow, in hearts of normal size or in hearts slightly or moderately enlarged. When the heart is greatly enlarged the movement of the muscle is often felt in the axilla and, because the surface of the chest is convex and because lung and chest wall intervene between the finger and the heart, a false impression is obtained. The movement is no longer forward but to the side, and the heart lies no longer behind, but to the right (in the body) of the palpating finger. Moreover it is no longer the musculature of the anterior surface of the heart which moves the chest wall, but as the heart swells and the impulse moves further back into the axilla, the left surface comes more and more into contact with the chest wall and gives the impulse. When the heart is materially enlarged therefore the outermost point of the maximal impulse is no guide to the left margin of the heart. Nevertheless it is an index of the heart's size and may be used as such.\*

*Diffusion of the impulse.*—A diffuse cardiac impulse is common in soldiers of to-day's armies. It is to be seen spreading from the 5th to the 4th and 6th and even to the 3rd and 7th interspaces, and occupying a large area in the precordial region. The movement, when felt with the palm of the hand, is as a whole quick and jerky, often giving almost, but never quite, the impression of a thrill. This diffuse impulse has been a frequent source of error in military diagnosis and prognosis. It has been and is still widely

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\* Needless to say, in this brief discussion, I neglect abnormalities in the position of the impulse such as arise from displacement of the heart or shrinkage of the left lung margin.



taught that a diffuse impulse is indicative of ventricular dilatation ; and so the sign is often used. It is true that a dilated heart is often accompanied by diffusion of the impulse,\* but it is true also that in most examples of diffused impulse dilatation is not present.† It is generally produced by a quick systole and an enhanced rate of beating. The diffuse impulse of which I speak may be confined to an area lying within the left mid-clavicular line ; it may spread well beyond this line and even reach the axillary region. At its outermost margin, or in its centre, lies the maximal impulse, a more definite thrusting movement ; and it is from the latter that the size of the heart is to be gauged. At other times the greater part of the impulse is seen but is not felt ; it is a mere quiver of the chest wall and is transmitted from a distance.

TABLE IX.

*Character of the cardiac impulse related to after-histories in the "effort syndrome."*

*(Disposition of 177 cases 11 months after leaving hospital for duty.)  
(Percentage figures).*

	Firing line.	Full duty overseas.	Prov. unit and full duty home service.	Light duty overseas.	Labour companies.	Light duty home service.	In hospital.	Discharged permanently unfit.
Impulse normal (122 cases)	15	16	18	3	7	20	3	18
Impulse diffuse (27 cases)	15	26	7	0	11	19	0	22
Impulse forcible or forcible and diffuse (28 cases)	11	21	14	4	21	14	0	14

If the rib spaces are felt lightly with the finger-tips, bringing them in step by step from the axilla towards the sternum over a diffuse impulse, the character of the impulse changes

\* In dilatation the movement is more undulatory and is more palpable, though these rules do not apply universally.

†An epigastric pulse gives no indication of the heart's size.



unmistakably as the margin of the heart is reached ; it then abruptly acquires a more vigorous and sustained character. In prognosis the diffuse impulse has little value ; patients who present it do not show less exercise tolerance than those who fail to present it ; moreover, of " effort syndrome " cases returned to duty, those who present the diffuse impulse do as well as those in whom the impulse is normal (see Table IX). A well-defined *maximal impulse* which lies beyond the natural limits, namely, an impulse situate more than  $4\frac{1}{2}$  inches to the left of the mid-sternal line or quite clear of the nipple line, is to be taken as a definite sign of the heart's enlargement. The sign is all the more emphatic if it is discovered in the 6th interspace ; it is less emphatic if found in the 4th.

*Movement of ribs or sternum.*—The transmitted shock of the heart, which creates the diffuse impulse in soldiers in whom cardiac enlargement is absent, is usually too feeble to lift the bony or cartilaginous structures of the chest wall, though it may cause them to vibrate. A definite and palpably sustained movement of the ribs, and especially of the lower sternum, is usually to be regarded as an evidence of enlargement therefore ; so too is a forcible and sustained thrusting movement involving several rib spaces, even though the pulsating area lies wholly within the nipple line ; this, however, is but rarely the circumstance in which it occurs.

*Percussion of the heart.*—There are physicians who believe that they are able to percuss the outline of the heart with an error no greater than a centimetre. Most of us have acquired confidence in percussion during the course of our clinical experience. Yet how many of us have ever tested the accuracy of the heart's limits as we percuss them against the orthodiagraphic outline or against the ascertained position of the heart in the cadaver ? The method is highly subjective and one which is especially apt to acquire an



exaggerated value in the minds of all of us. Accurate delineation of the heart's size by this method is not possible ; an accuracy of 1 centimetre is rarely attainable even in favourable conditions. The margin of the heart moves as much as that in systole, often it moves more. It moves also with respiration. The impression of a sharp margin of dulness is largely fictitious ; that must be the case in that there is a gradual recession from the chest wall as the intervening lung tissue gradually increases in depth. It is not difficult to percuss the left margin of dulness *when the position of the maximal impulse is already ascertained* ; subconsciously the pressure of the finger which receives the stroke becomes firmer when the impulse is reached. This is a pitfall which it would seem easy to avoid ; in practice it is not so easy to avoid, and is a very real factor. Those who have implicit faith in their power to percuss the heart's margins should essay this method blindfold and repeat the percussion in a rib space chosen for them by a critical observer who marks the limit as it is each time ascertained. Personal error, estimated in this fashion, is found to be not inconsiderable. It is less for the left side of the heart than it is for the right. An increase of the heart's dulness towards the left side is an important diagnostic aid, but it should not be allowed to overweigh the evidence given by the maximal impulse. A definite increase of dulness to the left is not to be read by itself as a sign of dilatation or of hypertrophy of the left ventricle ; it is to be interpreted, providing there is no displacement of the heart as a whole, as a sign of *ventricular enlargement*, without reference to the ventricle involved. A right limit of dulness is more difficult to ascertain than is a left limit. The most uniform results are obtained by first ascertaining the upper limit of liver dulness and by percussing inwards directly above this line until the right margin of the heart is reached. But I am convinced that, to most medical



men, at all events, the position of the right margin, ascertained by percussion, has little or no clinical value except in detecting or aiding to detect displacement of the heart. Many experienced and able physicians known to me pay little heed to the percussion of this margin in estimating the heart's size ; and their power of diagnosis does not suffer by this neglect. Many of those who are most content in the belief that to them this outlining of the right margin is usually, if not always, feasible, are imbued with the belief that it conveys information as to the doings of the right ventricle. Such is not the case ; if a margin of dulness is obtained it is almost always that of the right auricle ; an increase of dulness to the right, if interpreted, is to be interpreted as a sign of an engorged right auricle. Now there is a reliable sign of an engorged right auricle and it is within every physician's reach ; it consists of distension of the veins. The right auricle is never engorged unless the veins are distended, and these structures are exposed to view. In a healthy resting man, standing or lying at ease,\* all those veins are collapsed which lie above the level of the heart's base. In the erect posture the veins of the neck are collapsed and show little or no fluctuation ; the veins of the arms† of healthy men may be seen to collapse as they are lifted to the heart level. As a healthy man passes from the erect to the recumbent posture, the veins in the neck distend to become softly filled as he reaches the completely recumbent position ; at the same time they show those characteristic fluctuations in size which constitute the venous pulse. The venous pulse, if visible at all in healthy subjects standing quietly erect, is visible only at the extreme root of the neck. Over-distension of the veins is one of the most important physical signs which we

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\* There must be no unusual tension in the abdominal or thoracic muscles.

† In this respect the veins of the arm must be used discreetly, for they are not infrequently thickened.



possess of heart disease ; it should never be, but often is, neglected. In speaking of over-distension I mean to signify an increase of venous pressure beyond the normal for a vein placed in a given hydrostatic relation to the heart. It is of far greater consequence than any actual or supposed displacement of the right margin of cardiac dulness. It is an unmistakable phenomenon, one of those emphatic and legible signs of which we possess no surplus.

*Remarks upon murmurs and valvular disease.*

Murmurs are to be heard over the precordium in more than half the patients who are sent to military hospitals for actual or supposed cardiac affections. The significance of these murmurs has given rise to frequent and continued discussion ; the signs themselves have been a very prevalent source of error in military diagnosis and prognosis. For the unwary, the whole of this ground is pitted with craters, craters filled with memories of battles old and recent fought over them. I shall deal with certain types of murmur and discuss briefly their relation to diagnosis and prognosis.

*Cardio-respiratory murmur.*—This murmur is quite the most frequent. Usually of maximal audibility at the apex, it is often to be heard over a wide area of the precordium and in many cases is distinct at the angle of the left scapula. Thus it comes within the group of conducted apical murmurs, if indeed the term “conducted” may justifiably be employed at all. It has been and is responsible for innumerable and quite wrong decisions to discharge soldiers from the Army as permanently unfit. Usually it is readily recognised, being a short high-pitched, rather superficial whiff which is audible only (or most audible) in the inspiratory period of respiration. In reality it is probably a breath sound, the normal vesicular murmur being broken into two, three or more short murmurs,



each of which accompanies a cardiac systole. The cardio-respiratory murmur, as it is called, is usually associated with rapid heart action, whence its prevalence in cases which present the "effort syndrome." But it *may* be heard when the heart action is relatively slow and it is not necessarily confined to inspiration; it may occupy expiration also, and in rare cases *continues even when the breath is held*. In the last circumstance it is recognised by its character and by its accentuation during inspiration. The murmur has no diagnostic or prognostic significance. It is a natural accompaniment of an overacting heart and as such it should be construed.

*Pulmonary systolic murmurs.*—The next commonest murmur is a systolic bruit, soft or harsh, and audible over the 2nd, 3rd or 4th left costal cartilages. Frequently it is audible only when the patient lies, usually it is accentuated in the supine posture. It may or may not be accompanied by a similar murmur at the heart's apex beat. It has no prognostic significance, but may be used in diagnosis to remind the examiner that the heart's base should be felt for thrills. *Pulmonary stenosis and congenital patency of the ductus arteriosus.*—Both these conditions are extremely rare in our soldiers; in 5,000 soldiers sent to hospital for heart disorders, no more than 5 cases have been discovered. The conditions are rare because the signs are distinct and constant from day to day and permanent; consequently few who possessed such signs passed the recruiting medical boards. *Pulmonary stenosis* is never to be diagnosed unless a thrill, maximal in the region of the 2nd or 3rd left cartilage, is distinctly palpable or unless the patient also shows cyanosis of the lips, permanent or transient. The lesion is a serious one. *Congenital patency of the ductus arteriosus* is a lesion giving rise to variable signs. It may be diagnosed when a murmur is heard in the region of the 2nd



or 3rd left cartilage, which murmur runs without break through systole *well into diastole*. Such murmurs are almost always accompanied by thrills. The condition is not serious in itself but is often associated with, and hides the signs of, a congenital pulmonary stenosis or other congenital defect. If there is no cyanosis or cardiac enlargement and if and while tolerance to exercise is normal, signs of a patent ductus need not be heeded.

*Aortic systolic murmurs.*—Less frequent than the pulmonary systolic murmur, the aortic systolic murmur has no greater significance. Emphatically it is not to be taken as a sign of aortic stenosis, whether regurgitation is present or not. Almost all stenosis cases present a systolic murmur it is true ; but it is also true that very few cases which present systolic murmurs are affected by stenosis. Prognostically the murmur is valueless. It may be used to remind the examiner that he should have felt the heart's base for thrills or the pulse for its character. This murmur in men of military age is only rarely associated with a lesion of the aorta. The men are for the most part young ; the time required for the development of serious aortic sclerosis has not elapsed. In our armies, dilatation of the aorta or actual aneurism is rare ; a half dozen instances amongst 5,000 cases admitted for "D.A.H." or "V.D.H." is all I can recall. *Aortic stenosis.*—To diagnose aortic stenosis it is necessary *first to diagnose regurgitation*. The diagnosis of the former in the absence of the latter should be left strictly to the expert. Given the signs of regurgitation, then stenosis may be recognised when a systolic thrill is found at the level of the 2nd cartilage and the pulse is anacrotic or flat-topped. In aortic stenosis the systolic blood pressure is lower and the diastolic pressure is higher than would be the case if aortic regurgitation were uncomplicated. These are the only signs which are at all reliable. The



diagnosis of stenosis in the presence of regurgitation has but small value in assessing the disability or in arriving at a prognosis.

*Apical systolic murmurs.*—The commonest apical murmur is the cardio-respiratory and this is usually well heard far into the axilla, and is often conspicuous at the angle of the left scapula. A systolic murmur audible only while the patient is in one posture (standing or lying, but usually the latter) is next most frequent. Some systolic murmurs vary much in intensity and in quality from day to day, others are almost constant with change of posture and at repeated examinations. Naturally perhaps, those which are most constant are most suspect to have an endocardial origin; nevertheless a friction sound, resulting from a thickened pericardial surface, may possess the same constancy; and endocardial murmurs sometimes show inconstancy. There is a widespread tendency to ascribe the harsher murmurs to regurgitation. None of those qualities or relations offer a reliable means of differentiating. Almost any type of systolic murmur may be heard, a soft blowing murmur, a harsh rasp, a musical bruit, and at autopsy no fault may be found with the mitral valve or ring. The valve may be defective, or the ring may be wide, and there may be no murmur. The diagnosis of mitral regurgitation from the characters or conduction of the systolic murmur is uncertain; it is more certain where a murmur suspected of being due to this cause is associated with a history of rheumatic fever. Assuming regurgitation, the diagnosis of its cause—a damaged valve, a weakened muscle—is still problematic. If we are sure that mitral reflux occurs in any group of heart cases, then we are sure of it in those cases which present the signs of mitral stenosis. Yet in these the systolic murmur is variable in its occurrence, in its character and in its conduction. The first task of those who would use these murmurs for



purposes of prognosis is to differentiate those which are produced in the air passages (cardio-respiratory); it is imperative that these should be eliminated; the second task is to differentiate between these arising in the pericardium and those arising within the heart, no easy matter; the third task is to differentiate two classes of murmur arising inside the ventricular cavity, namely, those due to a lax ring and those due to a damaged valve; this last differentiation is not possible if the characters of the murmur are alone considered. But suppose that all these nice distinctions can be accomplished, which I do not admit; then where do we stand? Of what value prognostically is the knowledge that a relaxed ring is present? Little! for such relaxation is often transient; if it tells us anything, it tells us of a weakened myocardium and of this there are signs of greater reliability. Of what value is the knowledge that the mitral valve is slightly crumpled at its edges? The extent of mitral valve damage which produces a systolic murmur alone is slight; the value is uncertain; for very many men who possess such crumpling maintain it unchanged to a good old age. When diagnosed, mitral crumpling which produces simple regurgitation has not the same value in indicating myocardial damage as has mitral stenosis.

*Tricuspid systolic murmurs.*—A systolic murmur heard at its maximal intensity over the lower part of the sternum or ensiform region is usually ascribed to tricuspid regurgitation. This murmur, though less common than those already described, is not very infrequent in patients who present the "effort syndrome." The tricuspid valve is more easily rendered incompetent than is the mitral; strenuous exercise is sufficient to produce a murmur over the ensiform cartilage in many healthy people. Tricuspid incompetence, gauged from a systolic murmur of this kind, is not equivalent to heart failure; it is an incident which *may* be associated



with clear signs of heart failure ; but it is also an incident which happens in perfect health. The value of the tricuspid systolic murmur in prognosis is therefore negligible.

*Systolic apical murmurs are to be neglected in arriving at a prognosis in young men.*—I make this statement after full reflection and for the following reasons :—

1. The medical men generally do not, or cannot, differentiate between a systolic murmur which is and one which is not significant. Many believe they can. More men have been discharged wrongly from the Army (or have been over-assessed) on account of these signs than because of any other presented by the cardio-vascular system.

2. Even in the hands of experts the diagnosis of mitral regurgitation is uncertain.

3. The experienced often cannot trace regurgitation to its source.

4. Given that the source may be recognised, a crumpled valve, or a lax ring, carries with it no precise significance.

In discussing this question with those who differ in their view, I have been asked, do you attach significance to such murmurs when the heart is enlarged ?\* My reply is that I attach a value to *the enlargement*. Let me not be misunderstood. If 50 men are taken from the street and these have murmurs, and 50 others are taken who have none, then, unquestionably, the first group is relatively in bad case. But that is not the point, for some of the 50 with murmurs present symptoms and other signs. If the two groups of 50 men are alike in every other respect, if rheumatic fever has attacked one group as it has the other, if the hearts in the two

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\* The presence of enlargement does not alter the significance of the murmur ; this idea is based on the assumption that regurgitation produces enlargement. The hypertrophy produced by regurgitation is at the most trivial ; in many cases of undoubted regurgitation it is absent.



groups are of the same size, if the capacity of the two groups is the same for work, then the difference between them is negligible. The systolic murmur is not to be used as such ; it serves a sufficient purpose in indicating a group of patients in whom the cardio-vascular system is to be strictly surveyed. A history of rheumatic fever is sought, the heart's size is carefully estimated, special tests are employed to detect early mitral stenosis, the tolerance of physical exercise is judged or watched. If this plan is followed, the murmur is no longer needed. Thus the murmur takes its place where it belongs, *in diagnosis*, not in prognosis.

If from a large group of soldiers invalided for heart affections those who present mitral stenosis, enlargement, aortic disease, repeated or recent attacks of rheumatic fever, intolerance of physical strain, are eliminated\* (whether they have systolic murmurs or not), we are left with a body of men who may be sub-divided into two classes, namely, those with and those without systolic murmurs. Exercise tests show the one group to be quite as tolerant of physical strain as the other ; of "effort syndrome" cases sent out of hospital to duty, those with murmurs do almost, if not quite, equally well as do those who present no murmurs (see Table X and remarks upon it). Patients who are invalided on the ground of systolic murmurs alone are almost always subsequently found, *when tested*, to possess full exercise tolerance. This is the crucial test where prognosis is concerned. Auscultation is the least valuable method employed in sorting those soldiers to duty who are returned to hospital for supposed affections of the heart. The method has its chief value in detecting diastolic murmurs.

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\* A discovery of one of the first three is sufficient ground for discharge from the service ; the history of recent or repeated rheumatic fever should always turn the balance in the man's favour when his discharge is being weighed.



TABLE X.

*After-histories of "effort syndrome" cases with and without systolic murmurs.  
(Disposition 11 months after going to duty in 243 cases.)  
Percentage figures.*

	Pre- senting no mur- murs (90 cases)	Pre- senting mur- murs (76 cases)	Apical murmur (34 cases)	Basal murmur (15 cases)	Apical and basal (20 cases)	Other mur- murs (8 cases)
Firing line .. .. .	17	14	12	13	25	0
Full duty overseas .. ..	21	20	18	27	10	43
Provisional unit and full duty home service .. .. .	18	14	9	0	30	14
Light duty overseas .. ..	2	1	3	0	0	0
Labour companies .. ..	11	12	12	13	10	14
Light duty home service ..	22	22	26	27	20	0
In hospital .. .. .	2	4	6	6	0	0
Discharged permanently unfit..	7	13	15	13	5	28

The table gives in its first two columns the after-histories of patients with and without systolic murmurs in percentage figures. Actually the patients presenting no murmurs do a little better than those exhibiting murmurs; thus 17 per cent. of the former and 14 per cent. of the latter reach the firing line. But the difference is quite trifling; of patients presenting only apical systolic murmurs (3rd column) those reaching the firing line number 12 per cent., a fall of 5 per cent. as compared with patients presenting no murmurs; the figure for "provisional unit and full duty home service" is also low as compared to the figure for the cases without murmurs (9 per cent. and 18 per cent. respectively). These reductions in the case of the apical systolic murmurs are chiefly to be accounted for by the permanent discharge of many patients with such murmurs almost as soon as they leave hospital, and without trial, on the ground of the murmur. The actual correction for this I am unable to give, but know that, as it affects this table, it is not inconsiderable.

*Aortic regurgitation.*—Aortic disease in our soldiers is attributable to rheumatic fever or chorea in 54 per cent. of our cases (116 cases). This figure is higher than that accepted in civilian practice. That is so because women are less prone to rheumatic fever than are men, and because soldiers are young. Syphilitic aortic disease is for the most part a disease of middle age. Amongst our aortic cases a history



of syphilis, a positive complement fixation test, has been comparatively rare, having been found in only 12 per cent. of our cases.

In diagnosing aortic reflux reliance should first be placed upon the character of the pulse. The water-hammer pulse and its usual accompaniments (throbbing carotids, capillary pulsation and the pistol-shot phenomenon in the leg arteries) is the most reliable sign of the affection; but, when the amount of reflux is small and the arterial phenomena are inconspicuous, then the early diastolic murmur at the base of the heart is the chief, may be the only, sign. This murmur, be it noted, is heard maximally in cases of early disease with greater frequency to the *left* of the sternum than to the right. It is conducted downwards along the borders of the sternum and towards the heart's maximal impulse.

As a rule the diagnosis is not in doubt or, if it be in doubt, the symptoms on exercise or signs of enlargement are sufficient to preclude the patient from heavy work. From time to time there is difficulty, when the only physical sign is a faint diastolic murmur appearing to the left of the sternum. In such cases, and where there is a history of rheumatic fever or poor exercise tolerance, aortic disease may be diagnosed. Where help is gained from neither of these sources and the murmur stands alone, the diagnosis of aortic disease should not be made, but the man should obtain the benefit of the doubt and be classed lower from the point of view of fitness than he would be otherwise. Some of these murmurs, what percentage I do not know, are exocardial.

*Mitral stenosis.*—In our armies this condition is attributable to rheumatic fever or chorea in at least 65 per cent. of the cases. The figure is high as compared to usually accepted figures for similar reasons to those



stated under aortic disease. The diagnosis should never be made in the absence of the murmur\* which characterises the condition. An accentuated first heart sound, an accentuated or reduplicated second sound over the base of the heart, are insufficient signs even when a history of rheumatic fever is given. These signs are extremely common in over-acting hearts. Early cases may be detected by the following procedure. In all cases of suspected heart disease the patient should be examined by auscultation while he stands and lies, and lies after exercise. A very large percentage of all cases of mitral stenosis discovered in soldiers during the present war have been very early cases. The abruptly ending presystolic or full diastolic rumble of mitral stenosis should be diligently sought, and frequent attempts should be made to force it out in all patients in whom a systolic murmur is constantly audible at the apex or in whom the first sound is double† or in whom the first sound is greatly accentuated. Cases in which the murmur is brought out by the recumbent posture, or is audible for a few heart cycles *immediately after* a patient sits and lies quickly six times are as frequent as are cases in which the stenosis is diagnosable while the patient stands at rest. These tests‡ are therefore of the greatest consequence and should on no account be neglected. Briefly, they are to be employed whenever there is the suspicion of stenosis. If this procedure is employed few cases will escape observation and diagnosis becomes at once far more confident. Should the signs be no more than suspicious in a patient who lies down after a

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\* In very rare cases a thrill is present and no diastolic murmur can be detected; diagnosis from a thrill alone is not warranted unless the thrill is unmistakable and is unmistakably diastolic in time.

† I do not refer to a simple reduplication of the first sound, that is of little value, but to a wide doubling in which the two elements stand at an appreciable interval of time from each other.

‡ In rare cases an inhalation of amyl nitrite unveils a murmur inaudible after exercise.



simple exercise, a severer exercise is to be employed ; it is well also to examine the patient lying on his left side. If the murmur still remains inaudible but stenosis is still strongly suspected, the man may be classed provisionally slightly lower from the standpoint of health than he would be were there no such suspicion ; such an attitude is especially to be recommended in cases where there is a history of rheumatic fever.

Many cases of aortic disease and of mitral stenosis are wonderfully tolerant of physical exercise ; many patients in whom the disease has unquestionably been of long standing have seen heavy fighting and have been months or years in and out of the firing line. It is not on exercise capacity that I judge them to be unfit for any form of duty. To ask these men to discharge heavy duties, even in the absence of symptoms, would clearly be unfair to them.\* Generally speaking, the breakdown when it comes marks the beginning of total incapacity.

Neither mitral stenosis nor disease of the aortic valves is a complete diagnosis ; the presence of one or other of these lesions, of the latter especially, is to be read in general as indicating the existence of mischief more widely spread.

#### *Irregular action of the heart.*

There are but two common forms of irregularity in the heart's action amongst soldiers. The one is extrasystole, the other is a respiratory arrhythmia.

*Extrasystole.*—The extrasystole generally betrays itself by producing intermittence of the pulse ; at regular or irregular intervals the pulse beat lapses. This form of

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\* The retention of such men on *light* work in the Army has been advocated. It is undesirable from the standpoint of insurance.



intermittence is readily recognised for what it is. The only disorder with which it may be confused is a variety of heart-block, where responses of the ventricle to the auricle are occasionally missed. Amongst the soldiers of our armies, intermittence is due to extrasystole in all but rare instances. Diagnosis may be made absolute by attending to the apex beat. During the pulse intermission of extrasystole, the pulse at the apex is interrupted by a weak premature beat which is palpable or audible. The intermission of heart-block is uninterrupted at the apex.

Extrasystoles also occur more frequently, grouping the pulse beats in twos and threes. Such grouping of the pulse beats may be due in very rare cases to heart-block. As is the case with simple intermissions, if extrasystole is always held responsible, the error is so small as to be negligible. To distinguish absolutely between the two disorders in instances of group beating the man should be exercised. When the pulse rate is raised by exercise (to 140 or less) the group beating will vanish; while the heart is beating rapidly it should be listened to attentively and the first irregularity should be noted as the rate falls. In an instance of extrasystole, the first irregularity is signalled at the apex by a premature beat, in heart-block by a pause. There is no necessity to examine these cases instrumentally. Extrasystoles, whether they produce intermission or group beating, are without significance in prognosis. They are extremely common in patients invalided for supposed heart disorders. Heart-block is usually a sign of myocardial involvement and is serious.

*Respiratory arrhythmia.*—This disorder is also extremely frequent and has no more significance than extrasystole. It consists usually of a mild grade of irregularity which, though it may not be apparent at first, is related to the respiratory acts. But if the breathing is deepened, the heart



rate is noted to accelerate during inspiration and to retard in expiration. The irregularity is abolished completely when the pulse rate rises or is forced to 120 per minute.

*Auricular fibrillation.*—This is a serious disorder of the heart's action and indicates myocardial trouble. It is not nearly so frequent in soldiers as in civilians, but when it occurs it is usually accompanied by manifest signs of disease or heart failure. Whether it is so associated or not, it stamps the man as very seriously unfit. It may be diagnosed with considerable certainty by its relations and character.

1. It is the rule to find this disorder associated with a rapid action of the heart. It may be assumed without undue error to be the only irregularity of the heart accompanying rates of 140 or over. It is the only irregularity which is at all common when the heart beats at 120 or over. If a heart is beating irregularly below the rate of 120 and fibrillation is suspected, the heart's rate should be raised by exercise or by an injection of atropine (one-thirtieth of a grain intravenously). When the heart rate rises considerably\* then, if its beating remains irregular, fibrillation is to be diagnosed. It is the only cardiac irregularity which behaves in this fashion.

2. It is a persistent disorder, being present on all occasions upon which the patient is examined, from hour to hour, and from day to day, and in all circumstances such as sleep, changing posture, rest or activity.

3. It is often associated with clear signs of cardiac failure, *i.e.*, venous and liver engorgement, and may be with commencing dropsy.

4. The pulse is grossly irregular, the irregularity is neither grouped nor related to respiration, however deep the

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\* The higher the rate attained the more certain is the diagnosis.



breathing may be. Although the character of the irregularity is distinctive to those thoroughly familiar with it, this feature should not be regarded as the chief in diagnosing it. I have stated the points in the order of their importance.

*Paroxysmal tachycardia.*—This disorder is also rarer in soldiers than in civilians; it precludes full duty and in severe cases is to be regarded as a disabling malady. In this condition the heart rate rises without warning and quite abruptly from its usual rate to 140, 160 or even 200 per minute. The patient is usually conscious of the rapid heart action from the moment it comes. The paroxysm is generally repeated. Short paroxysms last a few minutes and may occur daily or several times a day. Long paroxysms last hours or days and are repeated perhaps weekly or monthly. The paroxysm ceases as abruptly as it starts and the patient is conscious of the fact.

To diagnose paroxysmal tachycardia, the patient should be interrogated as to the beginning of the attack and will usually volunteer a clear history of abrupt onset and offset. But in all cases in which the question of discharge from the Army arises, the patient should be seen in an attack. When witnessed, the nature of the tachycardia is easily determined. *The rate of beating is uninfluenced by posture, by rest, or by exercise.* This test is decisive, but the rate should be taken at the heart and not at the pulse. In some cases the paroxysms, if long continued, are accompanied by anginal attacks, or by venous engorgement; not infrequently, though wrongly, they are then referred to heart strain.\* Decisions as to capacity for light work should be left to those with special experience of the condition.

*Pulsus alternans.*—This sign is not found in young men with sufficient frequency to render it of value in military

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\* Exertion predisposes to attacks but does not create the malady.



practice. It is essentially a phenomenon associated with senile changes or advanced heart disease.

To sum up, the only irregularities of the heart's action which are at all common in soldiers are without significance. Those rare irregularities which are of diagnostic and prognostic value are usually accompanied by other clear signs of structural disease.

*Chronic myocardial disease.*

The fear of overlooking early heart disease, and especially of failing to recognise myocardial disease, is responsible for hesitancy in dealing with patients in assessing disabilities, and for blunders in classing men for duty and discharge. Myocardial troubles have in the past been wrapped in obscurity, but their diagnosis should no longer be mysterious ; providing certain general principles are recognised, there need be no fear of committing more than minor mistakes.

When the heart is definitely enlarged, a myocardial defect may be assumed, and the greater the enlargement the greater is the defect in the muscle. When there is a free aortic reflux, the assumption of myocardial disease is warranted in all cases ; when there is a developed mitral stenosis, myocardial disease may also be assumed as present, though not in quite the same degree ; these two valvular lesions, as I have said previously, are of chief value in bearing witness to myocardial troubles. When aortic reflux is slight or mitral stenosis is in an early stage of development, the myocardium should not be regarded as sound ; in most if not all of these cases there are at least minor changes in it. The degree of myocarditis is usually more in aortic disease of syphilitic origin than in cases of rheumatic origin, because syphilis affects the base of the aorta and often involves the coronary vessels ; as in rheumatic aortic disease, the muscle is also affected directly. In all



cases of thoracic aneurism, myocarditis may be assumed; most of such patients die of cardiac failure. In all cases of chronic renal disease or in cases of persistent high blood pressure the myocardium is to be regarded as unsound. The presence of fibrillation or flutter of the auricles, of heart-block or of pulsus alternans is sufficient to warrant a diagnosis of myocarditis.

Myocarditis leads up to cardiac failure, and the first indications of myocardial failure are detected by the patient; they appear in the form of symptoms, such as pain, breathlessness on exertion and easy fatigue. In all cases with which we have to deal it may be assumed that a degree of myocardial involvement, which is material to our purpose, will display itself through these symptoms; the exercise tolerance will always show reduction. When we deal with a mixed body of patients who are for the most part young, the converse conclusion, namely, that the presence of these symptoms is an indication of myocarditis, is not warranted. But uncomplicated myocardial trouble in the absence of gross valvular disease, renal disease, or signs of cardiac enlargement, is sufficiently rare in *young* men; we do not need to rely on symptoms. In the young reliance is to be placed upon associated lesions and upon signs of heart failure.

*Heart failure with congestion.*—The signs of this form of cardiac failure are familiar. The earliest sign is to be found in the veins; these show engorgement and the liver is generally involved at an early stage. In health the veins of the neck show no distension while the patient stands erect without strain. They become full just as he reaches the recumbent position and are then seen to pulsate, often freely.\* If when a patient stands, sits without raising the

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\* Pulsation of the neck veins is often mistaken for pulsation of the carotids. Venous pulsation is rarely palpable, is diminished when a patient stands and is often visible as a movement in the superficial veins. Arterial pulsation is always palpable and increases in the neck when the patient stands.



pressure upon the abdomen, or lies on several pillows, the veins are distended in the neck, then the pressure in the veins is raised. The veins of the neck or of the arm collapse in health when they are raised above the level of the heart's base. Engorgement of the right heart is never present when the veins show no increase of pressure. The later signs of this form of failure are cyanosis, crepitations over the bases of the lungs, great swelling of the liver, ascites, dropsy and reduction in the amount of urine passed. Breathlessness is the essential symptom. This form of failure is often accompanied by the gross irregularity of the heart's action which denotes fibrillation of the auricles; when fibrillation with its rapid ventricular beating is present it is largely responsible for the circulatory embarrassment.

*Heart failure with angina.*—Grave angina pectoris is uncommon except in middle-aged or elderly subjects. In these it is often the chief evidence of heart failure (the coronary arteries and the heart muscle being usually diseased). Where, as may happen, enlargement of the heart is inconspicuous or imperceptible, it is to be distinguished from less serious forms of cardiac pain occasionally encountered in patients who have no structural disease. The chief considerations in this differential diagnosis are :—

1. Grave angina pectoris is a malady of middle life or of advanced years. Amongst soldiers, the milder forms of cardiac pain are chiefly confined to the young.
2. Exercise is the chief provocative cause of pain in both types, but in grave angina the attack of pain is not experienced while the subject rests in bed, unless it is brought out also by mild exercise. In the milder form of cardiac pain, the attacks are not infrequent at night time and may be confined to resting hours.



3. Grave angina starts usually in the sternal region, the less serious type of cardiac pain starts in the region of the precordium. The radiation to neck and arms is very similar in the two types. Hyperæsthesia is present in both and over similar areas.
4. Signs of structural heart disease are often, though not always, present in the grave form, and alternation in the strength of the pulse beats (*pulsus alternans*) is frequently displayed ; not so in the less serious form.
5. In the less serious form the patient is usually highly strung and is often the subject of neuroses. He has the "effort syndrome," rapid heart action being the rule, and the response of the heart rate to exercise is exaggerated. In rare instances these attacks are ushered in by blanching of the fingers.

In soldiers, cardiac failure as evidenced by venous distension or by angina pectoris is clearly a ground for immediate discharge as permanently unfit. Cardiac pain of the milder forms, but having an anginal distribution, is usually an indication for discharge. When the attacks are infrequent and lack severity however, light or sedentary work may be undertaken.

If there is no sign of appreciable cardiac enlargement, if there is no gross lesion of the valves (mitral stenosis, aortic disease) nor aneurism, no serious disorder of the heart's rhythmic action, no engorgement of the veins or liver and no anginal pain, then the myocardium of young subjects may be pronounced sound, whether breathlessness is present or not. If some few patients with myocardial disease escape diagnosis under this plan of procedure, they are fully safeguarded by the observed reaction to exercise. A poor reaction will place them in light or sedentary occupations,



in which they are more closely under supervision, or it will discharge them. The myocardium may be pronounced sound in patients of all ages where exercise tolerance is good ; if breathlessness and fatigue are present at rest or on mild exertion the muscle may not be pronounced sound in men over 40 years of age even if there are no physical signs of disease. According to the degree of breathlessness they are to be classed lower from the point of view of fitness, and the grading downwards should become more drastic as age advances ; that is so because such uncertainty as exists increases with age, because myocardial affections become commoner as the later years of life are reached, and because the breathlessness is more commonly of cardiac origin (when signs of structural disease are absent) in older men.

Modification of the heart sounds can be used but very rarely, *and never alone*, to diagnose myocardial troubles. A weakening of this sound, an intensification or reduplication of that, the presence of a small element of sound in presystole or in early diastole, these signs by themselves are quite unreliable and should not be used further than to draw special attention to the condition of the heart.

A galop rhythm is by itself of no value ; it is often present in grave forms of heart disease, but in these it is almost always accompanied by other clear signs ; galop rhythm is a frequent sign in the "effort syndrome" and in these cases (in which it is most often heard) has no prognostic meaning.

*Fatty heart.*—Fatty degeneration should never be diagnosed. In civilian practice it rarely occurs in a severe form apart from acute infections such as diphtheria ; in the severe anæmias it is of milder type and forms no essential part of the diagnosis or prognosis. In disease of the coronary arteries in elderly people, in sufferers from grave angina pectoris, it is not infrequent in some degree ; in these patients



it is not diagnosable as such. It is often associated with, but is not necessarily the cause of, cardiac failure. *Fatty infiltration*.—This condition is an accompaniment of obesity in middle-aged or elderly subjects. It is not diagnosable apart from general obesity. Its frequency in soldiers is natural. It has little or no importance in military practice.

*Fibroid disease*.—Young subjects in whom fibrosis of the heart is widespread will always manifest clear signs of heart disease; the signs are those of myocardial trouble generally and include the symptoms and signs of one or other type of cardiac failure. In elderly patients, the signs of fibroid heart are sometimes less distinct; but the manner of dealing with these cases has been described sufficiently; elderly patients, like the young, will always have symptoms. Fibroid changes in the heart are due to one of three chief causes, namely, rheumatic or syphilitic infection of the heart or coronary arterial disease. In the last class angina pectoris is often present. The diagnosis of this malady on the basis of weak or muffled heart sounds is never justifiable. When the heart sounds are weak *over a conspicuous maximal impulse*, then the heart is often unsound, but such cases usually present abundant signs of other kinds; if there is doubt, and such doubts should be rare, such cases may be referred for special examination and reports. Briefly, it is far sounder to leave the diagnosis of a “fibroid heart” alone, as the diagnosis of “fatty heart” is left alone; the diagnosis is best confined to “failure” of one or other type, with such additions (valvular defects, enlargement, etc.) as may be made with confidence.

*Infective or malignant endocarditis.*

This disease, in which there is a progressive ulceration or vegetative inflammation of the valves of the heart, has become frequent amongst soldiers invalided as



“ heart ” cases ; the increase became most noticeable in May and June, 1918, and has since continued. A similar increase has also been noticed in the German armies. In all cases where there are signs of gross valvular disease, especially of aortic disease, and in which the spleen is palpable or in which there is conspicuous pallor or sallowness of the skin, this condition should be suspected. Although fever is present in most cases, it is often transient, short pyrexial periods occurring from time to time ; the patient may be *afebrile* for many months. Wasting is common in these patients, but embolic phenomena are those upon which reliance has chiefly to be placed. Embolism of any artery may occur ; but is most evident when the artery of the limbs, such as the brachial, radial or popliteal, becomes blocked, where a cerebral vessel is involved, or where the spleen is infarcted. Usually there is albumen and blood in the urine, though both these abnormal constituents are often present in small amounts. Small petechiæ are the rule, they are most usually of the size of a pin’s head, often present a pale centre, and fade away completely during a few days ; such petechiæ, when found in the skin, should be ringed with an indelible pencil and closely watched from day to day. They occur most frequently in the conjunctivæ, and in the loose skin above the clavicles, and around the folds of the axillæ ; they are also seen over the chest and abdomen and shoulders, and in other regions less often. A characteristic sign is the presence of indurated painful nodes in the tips of the fingers, of a faint blue or purplish colour, which come and go from time to time (Osler). Clubbing of the fingertips, slight in degree, is common in the condition. The disease is fatal with a very few exceptions ; it has been the only disease at all frequently responsible for deaths amongst our patients.



## CHAPTER V.

PROGNOSIS AND TREATMENT IN THE "EFFORT  
SYNDROME."

In attempting to assess the value of physical signs and symptoms so that from them we may forecast the duration of life, we set ourselves a prognostic task which, in the instance of many chronic maladies, our individual efforts may be unable to fulfil.

However astutely we form an *a priori* judgment, and in the first instance the majority of such judgments are of this kind, our conclusions are to be confirmed or denied by subsequent experience. The only final and fully reliable court of appeal is a comparison between the actual duration of life in two groups ; first, those who present the sign or symptom in question ; and second, those who present it not but who are in other respects similar. It is the labour which it entails and the length of time consumed in the case of long-continued maladies which in the past have chiefly limited a more universal adoption of this method of moulding prognosis. Because the method has not been widely applied to chronic maladies our power to prophesy the duration of life is still very limited.



*Prognosis of capacity for work.*

These preliminary remarks lead me to point out the contrast between the prognosis which considers the life period of a patient and the prophecy which pronounces a convalescent's subsequent fitness for work or duty.\* The latter is the easier by far to formulate upon a sound basis. In the main it is easier to formulate because the test of actual experience is more speedily accomplished. In dealing with invalid soldiers it is practicable to take samples of the common maladies, to examine the men, to tabulate the symptoms and signs, and to compare the details of these tables with the gathered after-histories. The prognostic value of a symptom or sign, in so far as it affects the after-history, can often be ascertained accurately within a period of twelve months following the discharge of a group of men from hospital, and in many instances well within this period. Such statistical work quickly raises prognosis to a level of greater exactitude and heightens the efficiency of the system of sorting which it affects.

The chief considerations in sorting trained soldiers for work or duty are those which are relevant in judging capacity to perform their tasks and to endure physical strain. There are other and important considerations; for example, their proclivity to infections (experienced for the first time or repeated), liability to accidents, consequent upon the state of health, which may affect their own life-histories or those of their comrades. To ascertain without fail whether an individual is or is not fit for a particular form of work is always possible; but it is possible only when a method is employed which is clearly impracticable, namely, setting the man fully to his task. That, so far as the pure

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\* In this chapter I discuss methods which have been in use to gauge the soldier's capacity for duty; but clearly similar methods are desirable in gauging capacity for civil work in the soldier about to be discharged, or to the civilian about to leave hospital.



question of sorting is concerned, is in general the only certain method. The considerations of past history and the physical examination serve one end, namely, the elimination of a number of those who, if submitted to the crucial test, would almost certainly fail or suffer. The usual medical examination serves the purpose of economy and safeguards the most unfit. So much will be at once acknowledged. But there are methods which lie between these two extremes—namely, the crucial test and the routine physical examination—and it is these intermediate methods which it is my chief purpose to emphasise at present. The crucial test as a universal measure is impracticable; the physical examination is inadequate. The last is only adequate in those patients where an absolute decision is possible; in the great majority of instances it is inadequate when judged from a rigid standpoint. The precise degree in which it is inadequate is unknown in the case of many common maladies, for the reason that in only a few specific instances have the decisions formed by these tests been checked by the after-histories of the men. Whenever this comparison has been instituted it has revealed the serious limitations of the simple physical examinations and the erroneousness of many of its deductions.

*Graded physical exercises as a test of fitness.*

While there are men at one end of the scale whom it is inadvisable to return to full work or duty, there are those at the other end of the scale whom it is advisable to pass as likely to remain competent. There remain those, and in several large classes of convalescents these constitute the largest sub-group, in which the decision rests upon *opinion* more or less firmly expressed. It is this sub-group which demands special consideration; it is to this that the intermediate methods are specially applicable. The measure of doubt in an



individual case dictates the subsequent procedure. To pronounce capacity\* to endure prolonged physical strain by inspecting the convalescents or submitting them to the stethoscope is not possible; to pronounce capacity after testing their powers of physical endurance by exercise tests of shorter or longer duration is possible in precisely the degree to which these tests approach the crucial test in severity. The plea which is urged is a plea for a wider consideration and trial of exercise tests as a chief means of grading generally, but of grading convalescents in particular, to various types of work or duty. Under our system no soldier has been judged fit for duty until his capacity to bear physical strains has been thoroughly tested; no man has been discharged from the Army unless he has shown clear signs of disease or unless, in the absence of such signs, he is proved to be incapable of physical exercise. All soldiers admitted to our hospital are submitted to a full physical examination, and within the first few days of their stay all cases presenting unequivocal signs of mitral stenosis, aortic disease, aneurism, or material cardiac enlargement are recommended for discharge as permanently unfit.† At this examination also are eliminated patients who suffer from manifest diseases of other systems, such as pulmonary tuberculosis, exophthalmic goitre, epilepsy. Briefly, all are eliminated in whom a positive decision can be reached, *none are eliminated in regard to whom a divergence of opinion may exist.* The whole remainder is submitted to graded exercises and marches, and the reactions to such exercises form the chief basis upon which the military prognosis relies eventually.

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\* To pronounce incapacity is sometimes possible.

† A few additional patients who give a clear history of repeated or recent attacks of rheumatic fever, who show very high heart rates and great breathlessness, or severe precordial pain accompanied by hyperalgesia, are now eliminated after a relatively short course of exercises; these are eliminated on the basis of former experience.



*The exercises.*

The exercises which we employ in sorting and treating cases returned to hospital for cardiac disabilities have no claim to be specific, as is sometimes erroneously thought. It would not be difficult to devise other exercise schemes which would be equally successful in similar and in slightly different circumstances. But any exercise system which is employed should be based upon certain general principles.

- (a) The drills or games should be graded so that no man is submitted to stiff exercises before his tolerance of easier exercises is thoroughly established. This safeguard for the patient is clearly essential.
- (b) For the same reason, the earliest drills should consist of easy movements and be of short duration. The later drills should consist of stiff exercises and should last longer, approximating in strain and in the kind of strain, as nearly as circumstances will permit, to such exercise as the man is liable to experience after he leaves hospital.
- (c) The drills in the case of the soldiers should consist so far as possible of exercises employed in the Army to which the men belong. They are then in large part familiar to the men who submit to them; time is not lost while they acquire knowledge of the movements. Army instructors of physical training are conversant with the exercises and are at once ready and competent to employ them. Lastly, it is only by employing such exercises that the capacity of the men can be thoroughly explored before they return to duty. The sharpness of



the words of command and the quickness of the movements have been subject to criticism on the therapeutic side. It is said, and it is in a measure true, that in highly-strung or nervous men, the sharp command shakes the nervous system; it is also said that quick movements are less beneficial therapeutically than slow movements. It is constantly to be remembered that the exercises are of equal, or greater, consequence in testing capacity than in treatment. The proper reaction to "snappy" orders and an ability to move smartly are required of the British soldier; in these respects therefore he must be tested. To use separate systems of sorting and treatment is not feasible. The introduction of slow movements is inadvisable in anything but the earlier drills; in these they may be used as a therapeutic preparation for the later drills; but used in this manner they have not been found in actual experience to present any great advantage.

- (d) It is wise to break the monotony of the longer drills by short set games in which the competitive spirit is called up and in which the alertness and the intelligent co-operation of the individual make for success. Such games enliven the drills as a whole and render the men more interested, responsive and willing to work.\*

The drills which we employ are therefore a selection from the code of Army exercises, which describes them in greater detail; they are grouped as follows:—

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\*Under really capable instructors the whole of the drills may be replaced by carefully selected games to advantage.



## TABLE XI.

*The drills.*

## DRILL I. (15 minutes.)

Heels raise and knees bend.  
 Arms sideways stretch, one arm upward, one arm downward stretch.  
 Trunk turning (feet apart).  
 Feet close and full open.  
 Trunk bending sideways.  
 Slow march.

## DRILL II. (15 minutes.)

Heel raising and knee bending quickly.  
 One arm upward, one arm downward stretch.  
 Foot placing sideways.  
 Trunk bending sideways.  
 Trunk backward bend.  
 Slow march.

## DRILL III. (30 minutes.)

This drill consists of drills I and II.\*

Men on drills II and III are sent for slow route marches of 1 - 2 miles in the afternoons, and are entitled to subsequent passes from the precincts of the hospital.

## DRILL IV. (30 minutes.)

This drill consists of drill II to which the following exercise is added :—

Arms forward bend.  
 Trunk turning.  
 Knee raising.  
 On the hands down.  
 Quick march.  
 Knee raising quick mark time.  
 Slow march.

## DRILL V. (30 minutes.)

Heels raise, knees bend, arm stretching sideways.  
 Head backward bend.  
 Arm swinging upward.  
 Trunk turning quickly.  
 Foot placing sideways.  
 Leg placing sideways.  
 Trunk bending sideways quickly.  
 Lying on the back down, leg raising.

On the hands down, arms bend.  
 Trunk forward bend, arm stretching sideways.  
 Knee raising, quick march.  
 On alternate feet hop.  
 Upward jumping.  
 Slow march.  
 Arm raising sideways, upward, sideways, downwards.

Men on drills IV and V are sent for longer route marches (4 - 5 miles) at an ordinary marching pace and are entitled to longer passes from the grounds of the hospital. The men on drill V enjoy additional privileges.

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\* The object of using the exercises of drills I and II again is to reduce the number of movements to be remembered.



All drills and games are conducted in the open air whenever the weather permits of it.

At suitable intervals all men are examined as they come from exercise. It is understood that any man who feels his drill or march to be beyond his power is to report at once to his medical officer. The drill instructors are ordered to report upon men who seem to them to tolerate exercise badly and, on the other hand, upon any men who fail to make reasonable effort. Co-operation between the medical officers and the instructors is a very essential feature of our system, and much is left to the instructor's discretion. It is the habit of most medical officers to see each man immediately after he has taken the first drill of each grade ; other officers prefer to raise the grade more automatically, and to await complaints from such men as feel themselves hard pressed. At the examination, whether it be at the dictation of the medical officer or drill instructor or at the wish of the man, questions of a general nature only are asked ; the rule is to allow the man to tell his own story ; it is inadvisable for the officer to introduce any symptom into the conversation. Notes are kept on simple forms provided for the purpose ; each symptom complained of is entered, as are corroborative signs and readings of pulse rate, etc.. This sheet forms in the end a summarised history of the work accomplished and the reaction to it. In the average, one or two examinations of each man are made weekly directly after exercise. Medical officers are careful to conceal so far as possible the particular symptoms or signs upon which they judge tolerance.

#### *Signs and symptoms after drill.*

The chief complaints of the men as they come from drill are of breathlessness, fatigue, precordial pain, palpitation and giddiness. It is essential that objective evidence of



symptoms should in each case be found before a complaint is allowed to weigh. Most patients emphasise a single symptom, and emphasise it constantly; a changing symptomatology can rarely be corroborated by outward signs and is to be distrusted. Some men complain on all occasions and in equal degree from the lowest to the highest exercise; others complain little. The medical officer has ever to be on his guard against those who exaggerate their sensations and equally on his guard against those who are reticent. The tolerance of exercise is to be judged by physical signs and not by symptoms; symptoms are chiefly of value in directing the attention quickly to physical signs. It has happened more than once that a medical officer has laid recognisable emphasis upon a particular symptom and that it has led to a corresponding epidemic in his service.

*Facial expression and breathlessness.* The facial expression when it exhibits genuine distress is generally that associated with breathlessness. The accessory muscles begin to be called into play, the alæ nasi are expanded, the tendons of the sterno-mastoid lift and the lips part a little; where there is greater distress the alæ nasi are active, the eyebrows are drawn together, furrowing the forehead vertically and yielding an expression of anxiety or actual pain, the mouth opens wider and its angles droop and the breathing is more audible. If questions are asked, the breathing is ill-regulated during the replies, the flow of words is interrupted by inspiratory movements. Not infrequently, and especially where there is fatigue, a slight but distinct duskiness develops under or around the eyes, pallor or sallowness of the whole face is not unusual. The facial traits deserve careful observation, for they cannot be simulated; rapid breathing is by itself a scarcely sufficient evidence. In a few patients in whom distress has been frequent and has been experienced



for long periods, the altered facial expression is maintained at rest.

A complaint of *fatigue* or *exhaustion* is rarely unaccompanied by other complaints, and may be disregarded unless often repeated and accompanied by signs such as pallor, uncontrollable tremor of lips or limbs or breathlessness, as the grade of exercise is raised.

*Precordial pain.*—This complaint is frequent ; it is to be checked by physical examination. With the chest of the patient stripped, the hands of the examiner are placed or spread symmetrically on the axillary and submammary regions, and pressure is exerted as though to steady the chest or to bring the patient to a more convenient position. This simple action may be sufficient to disclose hypersensitiveness ; in some patients, indeed, the slightest pressure on the left precordial region and a wide surrounding area is resented. In others it is necessary to slip the hands higher, bringing the thumbs over the border of the pectoral muscles and pressing again, or to proceed further, and, *while interrogating the patient*, to grasp the pectoral folds with increasing firmness between the thumbs or fingers. Where the muscles are sensitive on the left side the patient winces, the left shoulder is depressed, the facial expression alters or the reply is momentarily interrupted or actually broken off by a movement or expression of protest. Patients should not be asked, is this or that region sensitive ? When no hypersensitiveness of the left chest wall is detectable after exercise, the plaint of pain may usually be neglected. Hyperæsthesia is most conspicuous in men recently admitted. Pain in the axillary region, back or limbs is usually related to a particular action on drill and, as a rule, does not endure.

*Palpitation.*—A complaint of palpitation after exercise is to be neglected as such, but it is serviceable as a guide to persistent or excessive tachycardia. The rate may be normal,



raised or very high. To give actual rates might create a false impression. Heart-rate cannot be used by rule of thumb; rates vary too much with circumstances, and in general it is impracticable to render these uniform. However, the conditions pertaining to a particular hospital service may be maintained sufficiently constant for different patients and at repeated examinations of the same case. It is essential that heart-rates should be regarded broadly, and particular emphasis is to be laid upon consistency of separate readings. Thus, a patient who reports himself as disturbed by a given drill will usually show uniform high readings after that drill if distress is genuine; and these high readings will be foreshadowed by raised rates after drills of lower grade. Equally important is consistency between these drill rates, the routine ward rates, and the rate obtained by test exercises.

*Fainting.*—Although over 5,000 patients sent to us with diagnosis of “D.A.H.” or “V.D.H.” have now been submitted to graded drills, there has been no single accident of consequence. In the square where 500 men are drilled daily, one man falls down perhaps in two or three weeks. An appreciable increase in the numbers of faints at soldiers’ parades is to be regarded first from the standpoint of malingering. Some of the attacks on the drill ground are clearly unserious in their nature; the face is flushed, consciousness is not lost, the breathing is noisy and ineffectual, often sobbing, the face contorts, expressing not distress but irritation or vexation; the body is held rigidly and such movements of the limbs as occur are for the most part purposeful. The eyelids are held tightly shut, and the opening of them is strenuously resisted. Such manifestations stamp the attack as hysterical or assumed; these attacks often coincide with the visits of medical officers to the parade ground. As a rule a fainting attack should not break the routine of drill for more than forty-eight hours.



*Simulation in soldiers.*—If it were wise it would be impossible to hide the meaning of the exercises or their use for sorting purposes from the soldier patients, seeing that they come to understand the significance of any deliberate special examination. We believe that complaints of distress where absolutely no distress exists are on the whole rare. Such complaints do not deceive ; the manner of their presentation awakens doubt ; they are unaccompanied by objective signs or the signs are incompatible with the complaint.

The over-emphasis of symptoms actually experienced is somewhat more difficult to recognise and is undoubtedly common ; it is recognised by the same careful comparison of the objective and subjective. Medical officers will be well advised to guard against wilful efforts to produce or to exaggerate signs of distress. A man returning from exercise to the medical officer's room will from time to time sprint on the flat, dash upstairs, or perform vigorous exercises before opening the door and presenting his wrist for examination. But such attempts are not easy to maintain, and repetition is essential to their success. The man must repeatedly risk detection by a member of the staff, or maybe fails to find his opportunity ; in the last case his observed reaction is out of harmony with former reactions. The genuineness of a sudden increase in the reaction to exercise is to be tested by visiting the man while he is at drill, or by imposing simple exercise tests in the examination room or ward. The constant supervision of drill by medical officers has been abandoned as both unnecessary and inexpedient ; the men work better and more uniformly when left to the drill instructor. No doubt the voluntary production of distress is overlooked from time to time in individual cases, but it cannot long be concealed from the man's comrades, and many of these at once resent the deception. If less gross, the deception may be contagious, and comes to be practised by small groups of men ;



its early discovery is from that time certain. When discovered, it is met at once by placing the man or men upon a higher grade of drill without comment.

The other and brighter side of the picture is the man or men who steadily refuse to complain ; these tax the medical officers' power of discrimination most of all. Medical officers who get to know their men, who can win their confidence, who treat them tactfully and fairly, experience little difficulty. By far the larger part of our patients desire only full examination and consideration and recognise the justice of the final decision, understanding for themselves that they are judged for grade of service according to their proved tolerance for work.

" Effort syndrome " cases which progress to the highest exercises and carry them out without distress in conjunction with route marches are sent to full duty ; men who progress more slowly and those who tolerate the highest grade of exercise less perfectly are sent to command depôts for further training, or are recommended for suitable light duty categories. Men who show symptoms and fail to improve on the lower grades of exercise are recommended for sedentary duty or are discharged as permanently unfit from the Army. In classing men and in recommending categories of duty it is wise to maintain the standard of recommendations uniform by analysing the percentage results at regular intervals. The class of case has not been found to vary appreciably during the period of the war. The actual percentage figures of patients leaving hospital has approximated to the following during the present year (1918) :—

TABLE XII.

Fit for general service .. ..	20%
Fit for hardening or labour .. ..	30%
Fit for light or sedentary work .. ..	30%
Permanently unfit .. ..	20%



*Examples of after-histories of soldiers discharged to duty.*

The success or want of success of such a system as has been described can be gauged only by actual experience, and this I am in a position to relate. It is now two years since the system was introduced and during this period over 5,000 patients have passed through our hands, the average stay of the patients in hospital having varied between six and ten weeks.

*After-histories of the earliest group.*—Between the months of May and November, 1916, some 558 cases who had successfully passed the preliminary examination, intended to eliminate the obviously diseased, were discharged from hospital. The whole of this group during its stay was submitted to graded exercises and marches, and the military prognosis was based chiefly upon the reactions to these exercises. Of these 558 men, 286, or approximately 50 per cent., were judged to be unfit for any category of duty then available. The remaining 272 men were recommended for one of the several duty categories. The actual recommendations are given in the left-hand column of the accompanying table, as they apply to 239 of the 272 men.\* These are all the men of the group in whom a satisfactory comparison between the recommendations and after-histories can be instituted.

Inquiries were made in regard to all the 272 men, and we received information in respect of all but 9 of them. An average period of 11.2 months elapsed between the discharge to duties and the receipt of the replies. The table may be summed up. Of the 239 men 119 were recommended as fit for duty (72) or as likely to prove fit within three months (47); 109 men had proceeded on full duty overseas (79) or were in provisional units (30); 120 men were recommended for light or sedentary

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\* Thirty-three men have been omitted; in 9 of these I am unable to give the after-history; 1 man has since been discharged as time-expired; 1 has since deserted. The remaining 22 men have been transferred to Reserve cases—i.e., as fit for service but deemed of greater value in civil life.



TABLE XIII.

*After-histories of 239 men. (May-November, 1916.)*

<i>Recommended.</i>	<i>Disposition within 11 months.</i>
72 Fit for general service.	35 in the firing line 23 not known if in firing line. 21 known not to have been in firing line. <span style="font-size: 2em; vertical-align: middle;">}</span> 79 full duty overseas.
47 Likely to be fit for general service within three months.	30 in provisional units. 8 on full duty home service.
20 Light duty, unlikely to be fit for overseas within three months.	7 light duty overseas. 23 labour companies at home.
68 Light duty, but unlikely ever to be fit for service overseas.	33 light duty home service. 16 sedentary duty at home. 5 under treatment.
32 Sedentary work at home.	38 discharged permanently unfit.

duty ; 87 men were performing these duties when the replies were received. Of the whole group of 239 men, only 38 had been discharged as permanently unfit from the Army after leaving hospital, 5 additional men were unfit in lesser degree and were under treatment, 16 men were on sedentary duty at home. Compare the recommendations with the after-histories. The comparison at once establishes the soundness of the sorting system employed. The system at this its preliminary trial proved sound because its basic principle, the sorting of men for physical work by testing them at physical work, was sound.

*Detailed consideration of after-histories.*—The actual after-histories of the 239 men may now be considered in more detail. Of the 86 men who proceeded overseas, 35 are known to have reached the firing line, 44 are entered in the table as having been on “full duty overseas” and 7 on light duty overseas. It is desirable to consider the first two sub-groups further. The records of the 35 men who are known to have reached the firing line are as follows : 8 men were wounded one or more times, and were evacuated for their wounds ;



4 became "prisoners of war"; 8 were still in the fighting line and had been there for an average period of 4 months at the time the replies were received; 2 were in the trenches for an average period of  $2\frac{1}{2}$  months and were evacuated for shell-shock and trench fever; 4 were in the trenches for periods varying between 3 and 22 months and were eventually sent down for a recurrence of the old symptoms; the remaining 9 failed to make good in that they reported sick and were placed on light duty before they had been one month in the trenches. Thus, of the 35 men known to have reached the firing line, 26 may be considered to have made good. These figures are to be read as representative of the figures for all such men returning to the firing line.

The 44 men entered as having been on full duty overseas are subdivided as follows:—

TABLE XIV.

*"Full duty overseas" group.*

23 not known if in firing line	{	(1) Evacuated for "effort syndrome" ..	4
		(2) Evacuated for other reasons..	3
		(3) Further history unknown ..	16
21 known not to have been in firing line.	{	(1) Carrying on full duty.. ..	13
		(2) Full duty intermittently ..	2
		(3) Under treatment or evacuated for "effort syndrome" ..	3
		(4) Labour units .. ..	3

To sum up, of a group of 558 men, 286 were discharged as permanently unfit, and the remaining 272 were classified for duty. Of these we may justifiably eliminate 33 men; of the remaining 239, 86 (or 36 per cent.) passed overseas within shorter periods than 11 months. A further number, 30 (or 12 per cent., making 48 per cent. in all), were in provisional units before the end of 11 months. Of those passing overseas—namely, 86 men—I am unable to give accurately the percentage reaching the firing line; it is known to be as high as 41 per cent. and to be less than 75 per cent.; the intermediate figure, 58 per cent., may be taken as an approximation.



Thus in dealing in round numbers, it is known that of a large unselected group of cases, drawn from the overseas and home forces, 50 per cent. may be rendered fit for full or light duty, while 50 per cent. should remain in the sedentary class or be discharged unfit.\* At least 15 per cent. of the men can proceed overseas in lesser periods than 11 months and a further 5 per cent. are ready to proceed a little later; it is estimated that more than half of these men (*i.e.*, more than 10 per cent. of the whole) reach the firing line and that the majority of these make good there. These figures may be taken as representative for invalid soldiers suffering from "effort syndrome" and treated and sorted by a system of graded exercises.

It would seem clear from the figures given that sorting and treatment of the large class of soldiers rightly or wrongly suspected to be subjects of cardiac disabilities has been eminently successful; the system of so dealing with these men has become widespread, and medical officers who have experience of graded exercises appear to be of the unanimous opinion that they are essential both to efficient sorting and to efficient treatment.

*Influence of rheumatic fever and length of history.*—The influence of a history of rheumatic fever upon the return overseas is clearly shown in the accompanying table. Of 65 cases dating the onset of their symptoms from rheumatic fever, 1.6 per cent. are known to have reached the firing line and to have made good there, a further 3 per cent. were on full duty overseas within 11 months of leaving hospital. The figures for the non-rheumatic cases, on the other hand, are 5.4 per cent. and 9.1 per cent., respectively.

Those patients do best in whom the symptoms begin on active service; those do worst in whom the onset is dated to

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\* Those placed in sedentary classes in 1918 outnumber those discharged as permanently unfit.



civilian life. Of the first group 5.7 per cent., of the last 2.6 per cent., are known to have reached the firing line and to have made good there within 11 months of leaving hospital. The figure for discharge as permanently unfit for the service is 18 per cent. higher for the last group than the first.

TABLE XV.

*After-histories of "effort syndrome" cases, related to rheumatic fever and time of onset.*

*Disposition of 525 cases within 11 months. Percentage figures.*

	Onset from rheu. fever 65 cases.	Remainder 460 cases.	Onset before joining 236 cases.	Onset on training 62 cases.	Onset on active service 228 cases.
Firing line, make good	1.6	5.4	2.6	1.6	5.7
Full duty overseas	3.0	9.1	6.4	13.1	9.7
Prov. unit and full duty home service	7.7	7.2	5.9	4.9	9.3
Light duty overseas	1.6	1.3	0.8	—	2.2
Labour companies	4.6	4.4	2.9	3.3	5.3
Light duty home service	3.0	10.2	7.2	14.8	10.2
Hospital	—	1.1	0.8	—	2.2
Firing line, fail	4.6	1.3	1.7	—	2.7
Permanently unfit	73.8	60.0	70.8	62.2	52.7

*Incomplete after-histories of the latest group.*—The following after-histories apply to a group of 1,080 "effort syndrome" cases finally dealt with at the hospital during the months of January to May inclusive in the year 1918. These men were all patients received from the Overseas Forces, directly or indirectly. Of the whole number, 192 (or 18 per cent.) were discharged as permanently unfit for any form of duty from our hospital. The remaining 888 men were sent out as follows :—(i) 224 (or 21 per cent.) to



their regimental dépôts as fit for general service after hardening ; (ii) 353 (or 32 per cent.) to command dépôts for further training and sorting to full duty, light duty, etc., and (iii) 311 (or 29 per cent.) to their regimental dépôts as suitable for light employments and sedentary work.

Month by month, inquiries were sent out in respect of these 888 men, and the following table shows the disposition of 860 of these three months after they left hospital.\*

TABLE XVI.

*Disposition of 860 "effort syndrome" cases three months after being sent to duty. (January-May, 1918.)*

<i>Disposition.</i>	<i>Numbers.</i>	<i>Percentages of 860 cases</i>	<i>Percentages of 1080 cases.</i>
Overseas .. .. .	100	12	9
Provisional units and full duty home service .. .. .	180	22	17
Labour companies .. .. .	46	5	4
Light and sedentary duty ..	261	30	24
Still at command dépôts ..	131	15	12
On the reserve as of more value in civil life .. .. .	17	2	2
Dead .. .. .	1	—	—
In hospital .. .. .	43	5	4
Discharged after leaving hospital	81	9	8
Totals .. .. .	860	100	80†

This batch of after-histories is the most favourable we have obtained ; 12 per cent. of the men sent to duty were on full duty overseas within three months of leaving hospital ; 22 per cent. were in provisional units or on full duty at home, making a total of 34 per cent. This percentage, according to our past experience, will rise a good deal when the six months after-histories are obtained. Only 9 per cent. of the men have been discharged the service since leaving hospital, and this figure, as past experience shows, will not

\* 28 have been excluded ; 3 are in prison, 7 are deserters, and answers are still awaited in the remaining 18 cases.

† The 100 per cent. is completed by 2 per cent. untraced, etc., and 18 per cent. originally discharged unfit from the hospital.



increase materially as later answers to inquiries are received. The remainder of the men were in labour companies (5 per cent.), were performing lighter duties (30 per cent.), were still in training in command dépôts (16 per cent.), or under treatment in hospital (5 per cent.).

*Course of the "effort syndrome" and its treatment.*

The natural course of the "effort syndrome" is in a large number of patients towards recovery. An early change for the better has been especially noticeable in men returned directly from the fighting areas. In these it has been the rule to find considerable improvement during the first week or so under a suitable hygienic régime. This immediate and usual advance towards health is attributable in part to the removal of those causes which, in the war areas, aggravated the symptoms, namely, the tension and anxiety of mind, the arduous physical work, the irregularity of habits in feeding and sleeping and the exposure of the body to wet and cold. Men who came from abroad enjoyed, for a while at all events, a blessed feeling of security, itself a powerful sedative and counteracting the ill-effects of the old mental and physical strains. But improvement has also been witnessed, though not quite in the same degree, amongst men sent to hospital from the home forces. The exercise and outdoor life lead them back to a more vigorous habit of body than they have for some time past enjoyed. The exercises are to be combined with treatment by suggestion. A first essential of successful treatment is to persuade the men that there is no real cardiac ailment and that such sensations as they attribute to the heart have in reality another source of origin or are due to a temporary and unserious disturbance of the organ consequent upon general lack of tone and fitness. The exercises powerfully aid this suggestion by demonstrating the capacity of the body for work. The men see the



progress of their comrades towards health ; they feel progress themselves, though the admission of such progress *during the stay in hospital* has naturally been infrequent. Bed is bad for these patients ; from every standpoint its influence is pernicious. Treatment by means of drugs is ineffectual in so far as the chief symptoms are concerned. We have tried many such remedies ; they have been without success. The dispensary limits its activities to the compounding of laxatives and such minor remedies as palliate headaches or pains in the chest. Here and there a tonic may be given, here and there anæmia is treated by iron and arsenic ; but in the main our patients are kept away from the medicine bottle. *Digitalis*\* has no beneficial influence upon the symptoms or signs ; it could hardly be expected to have such influence. In a section of the patients as a whole, the initial improvement continues and health is quickly and completely restored ; more frequently progress becomes slower and several or many months may elapse before the symptoms sufficiently abate to permit return to active duty. In the majority of the patients, progress occurs to a point and there is no further improvement, health remaining impaired or imperfectly restored. In general, it may be said that the health of the men treated as a group is raised, and more than perceptibly raised. Those, therefore, who on admission have been mild instances of the affection have reached or almost reached a state of fitness ; those who on admission have been severe cases have not as a rule returned to high grades of duty. It is to the slight or moderate move towards health in the men as a group, which brings the more favourable subjects out of the borderland of ill-health, rather than to startling progress in individual instances, that the success of our method is to be ascribed.

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\* *Digitalis* has little or no value in treating soldiers with a view to their return to duty. Those who need the drug are unfitted to remain in the Army.



In a few patients improvements of a conspicuous kind have followed the discovery and treatment of a local source of poisoning. The condition of the teeth and of the throat are especially watched and, in so far as is possible, discovered defects are remedied.

Our after-histories often bear witness to improvement in men returned to duty. Patients sent from hospital to light or sedentary duties have not infrequently passed subsequently into the higher categories, have appeared in the fighting line and made good there.

Amongst those discharged unfit there is also improvement; so we judge from letters which they have written to us, and from an examination of those who have returned to report themselves.

A few patients after leaving hospital develop more serious symptoms and signs and pass into the more definite categories of tuberculosis or early heart disease. But the number of such developments has not been great so far; we shall possess more knowledge of them when, with the lapse of a few more years, the patients have been traced further.



## CHAPTER VI.

## SOME GENERAL CONSIDERATIONS.

*Faulty methods of recruiting.*

Many of the errors which have been committed in dealing with so-called cardiac cases were the unavoidable outcome of our unpreparedness for war in August, 1914. Some of these have since been remedied, with others the time for remedy has passed ; some avoidable faults have remained. We learn in a school of painful and expensive experience ; by reviewing past defects, error may be reduced in the future. With the rush of volunteers in the early days of the war and the inadequate supply of medical officers, the acceptance of many men wholly unfit for military duty was inevitable.

TABLE XVII.

	Onset of symptoms.			Invalidated on training.	Invalidated on active service.
	Before joining.	On training.	On active service.		
" Effort syndrome " (558 cases)	242 (43%)	65 (12%)	251 (45%)	125 (22%)	433 (78%)
" Heart disease " (101 cases)	37 (36%)	30 (30%)	34 (34%)	32 (32%)	69 (68%)

The original recruiting boards were faced by the problem of eliminating in a few minutes those who were unfit ; in a measure they failed. They failed because the exercise



tests employed were insufficient. All such boards used a preliminary examination, a scrutiny of the stripped man, his percussion, his auscultation. Such an examination will eliminate the greater portion of those who present evident signs of disease. But this examination discovers a number of signs, the precise significance of which is in doubt. Such men are passed or failed upon very slender evidence if the examination confines itself to physical signs. A large number of men who suffered from early heart disease, especially from early rheumatic heart disease, passed into the Army. Amongst cases of actual heart disease (a term which includes in the main definite mitral stenosis, aortic disease or enlargement) returned to hospital during the first two years of the war, an onset of symptoms before joining was ascertained in 36 per cent., on training in 30 per cent., and on active service in 34 per cent.. In at least 50 per cent., recognisable lesions were probably present on enlistment and a more searching examination for physical signs could have eliminated a large proportion of these recruits. As a class, these cases were 7·4 months in training, and 4·4 months in hospital to the date of their discharge from the Army. In return for these 11·8 months they had given 0·3 month of light duty and 4·0 months of full duty. A graver event was the passage into the service of a host of men suffering at the time from the long experienced symptoms of the "effort syndrome." At the time of recruitment they presented no resting physical signs; they could only have been eliminated by exercise tests. The exercise tests employed by the recruiting boards were wholly inadequate. As often as not no test worthy of the name was employed; a few hops along a room was the generally accepted maximal standard. In dealing with men eager to become soldiers, the omission of adequate tests of physical capacity was a serious blunder. In my opinion half the cases of "effort



syndrome" (*i.e.*, those most seriously affected) included in the drafts of the first years might have been excluded by testing their tolerance to exercise. The consequence of their inclusion may be judged from the following observations.

TABLE XVIII.

*The average length of training and stays in hospitals and duty rendered (compared to the duration of symptoms).*

Symptoms.	No. of patients.	Average training, including some light duty (in months).	Average duty before onset (in months).	Average duty after onset on foreign service (in months).		Average stay in hospital (in months).
				Light.	Full.	
"Effort syndrome" { Onset before joining	242	6.1	0	2.0	2.8	5.2
	65	7.0	0	0.7	2.2	5.3
	251	9.0	6.1	0.6	1.5	5.5
Heart disease	101	7.4	—	0.3	4.0	4.4

Amongst cases of the "effort syndrome" sent to hospital during the first two years of the war, the symptoms were present on enlistment in 43 per cent. of the cases and in another 12 per cent. appeared on training; in the remainder (or 45 per cent.) they appeared during active service. The first group was trained for an average period of 6.1 months, and at the time of computation (late in 1916) had spent 5.2 months in hospital. In return for these 11.3 months, the group had given to date 2 months of light duty and 2.8 months of full duty. The active service group was trained for 9.0 months and had spent 5.5 months in hospital. In return for these 14.5 months, they had given 7.6 months on full and 0.6 month on light duty.

*Remarks on exercises in gauging capacity.*—The exercise system, as it has been described in Chapter V, is especially



suited to fully trained men who have broken down subsequent to or during the periods of training. Upon each of these men much time, and much money, has been spent. The training which each man has received represents capital. The system is especially suited to the sorting of a body of men known beforehand to be suffering from defects more or less incapacitating. It has an equal value in being readily adaptable as a remedial measure in treating sick or convalescent patients. Such a system, entailing a six weeks stay in hospital, would clearly be unjustifiable were it not for these important considerations.

In recruiting from a normal population, the assumption is that each man is sound till he is proved unhealthy. For untrained men, therefore, such a system has to be governed by necessary economy.

The simple conclusion, that a man's capacity for work is ascertained most certainly by putting him to work and by watching his reaction, has been accepted tardily. Methods of examining recruits have certainly improved, recently suitable exercise tests have been more often utilised, but even at the present time the value of this method is by no means fully appreciated. Unsuitable recruits have recently been admitted to the service, others have been wrongly graded, because sufficient tolerance tests have not been applied. Upon recruits drawn from sedentary occupations,\* such tests *as would render a healthy man distressed* should always be used before grading them for full service. The need for searching exercise tests has grown as the reserve drawn upon has become smaller and of lessened quality. Such tests are not difficult to devise, but they are necessarily governed by the circumstances in which the men are examined and by the purpose of the examination. The reaction of a healthy man to any exercise,

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\* In some classes of recruits, those drawn from heavy trades, exercise tests are often redundant.



employed as a routine, will quickly become known to the medical officers who employ it. An exercise test places the men approximately in the order in which they tolerate physical work, and that is more than half the battle in grading men for service, as it is in categorising patients for duty. It is an asset whose value increases in direct proportion to the amount of work accomplished and to its duration. Even minor tests, such as walking up a flight of stairs or hopping 10 or 20 times on each foot have a very appreciable value ; such tests are very helpful but are not entirely sufficient, even in the case of recruits. In judging exercise tolerance in hospital patients, or in gauging tolerance for pension purposes, they are more than insufficient.

*Training without discrimination.*

To take men in large numbers from sedentary employments, to take young men, not yet fully grown, to place these in training camps, to submit them from the first to long marches and strenuous exercise and drills, was to court a wastage of our man power. Many men broke down and showed the " effort syndrome " in the first few days or weeks of training. Men unaccustomed to exert themselves, men still of tender years, need a cautious introduction to hard physical conditions of life. The safety of a more graded system has recently been recognised. But a fault of an almost precisely similar kind has been and remains prevalent ; it is the quick return of men from hospital, where they have been treated for acute illnesses, to their units. There has been no general system in the home services by which convalescent men could be tested as to physical fitness under close medical supervision. Convalescent hospitals are in chief part rest-houses. No man who has been sent to hospital because his duties have caused distress or because of acute illness



should be returned to duty until his medical officer has ascertained his fitness for such duty by watching his reaction to physical tests of strength and endurance. A training ground should be available in the grounds of all large military hospitals, or training depôts should be available to which the convalescent men could be sent and yet remain under close medical supervision.

*Faults in treatment.*

*Length of hospital stay.*—The average stay of patients suffering from actual heart disease was no less than  $4\frac{1}{2}$  months during the earlier period of the war, although the majority of these patients were not in need of hospital treatment. This waste of hospital accommodation was attributable to the prevalent system of treating patients with heart disease as bed cases, despite the presence of good or fair exercise tolerance; it was attributable to lack of expedition on the part of medical officers in discharging patients subsequent to the decision to discharge, and it was also attributable to the time wasted in preparing the papers necessary for pension purposes. These defects were recently removed in large measure

The average hospital stay of patients belonging to the "effort syndrome" group was 5.3 months in 1916. In these patients, the chief cause of delay was the indecision of medical officers; they were unable to form a final opinion as to fitness for duty and delayed accepting the responsibility of returning men to duty. Patients were frequently transferred from one hospital to another, staying a full term in each. Amongst those ultimately discharged from the service the same causes of delay were apparent as in the instances of real heart disease.



The average stay of patients suffering from the "effort syndrome" became materially reduced after the earlier years of the war, but for 1918 stands not far short of  $3\frac{1}{2}$  months. The universal treatment of these cases on convalescent lines would have reduced the average to 2 months or less. We have received recently at Colchester a large number of patients who have been retained as bed cases for periods of many months in other hospitals. We have always preferred to receive patients as soon as possible after they report sick and in such cases have been able to dispose of them finally in an average period of six weeks. It is to be remarked in this connection that of patients so dealt with by us only a small percentage has subsequently been found to be under treatment in hospitals at the time of inquiry.

*Bed treatment.*—The bed treatment of real heart cases is ill-advised in all cases in which there are no signs of cardiac failure. The bed treatment of cases showing the "effort syndrome" is deplorable. The patients deteriorate in health; they become undisciplined and hospitalised; it becomes ever more difficult to disabuse them of the notion that their hearts are diseased. The inevitable tendency of bed treatment is to exaggerate the complaints and to render them more persistent.

*Army terminology.*—The Army classes its patients arbitrarily. Up to June, 1918, over 36,000 "heart" cases had been discharged as unfit, and a greater number had been returned to various categories of duty in the Army; all of these men were told in what is to them definite language, and most of them were told many times over, that their hearts were unsound. The patients of whom I speak are for the most part classed as "disordered action of the heart" or as "valvular disease of the heart"; to the average soldier the one is as serious as the other. Probably not one soldier in a score to whom such diagnoses have been applied but



believes himself crippled by a defective organ. A cardiac diagnosis is generally misunderstood by patients to whom it is applied; heart disease to many is synonymous with chronic invalidism or a rapid or abrupt termination of life. Yet not more than 10 per cent. of these soldiers have real cardiac mischief, not more than a tenth of them have such structural disease of the heart as will seriously affect their after-histories. Unwittingly the Army has done a monstrous thing. It is deplorable that a diagnosis conveying the meaning of cardiac unsoundness should be used in cases in which no evidence of structural lesions can be discovered; the terms "D.A.H." and "V.D.H." are going to rank with rheumatic fever in their responsibility for invalidism. In diagnosis, reference to the heart prejudices not only the treatment of the patient but also in high degree his return to duty. Undoubtedly the symptoms constitute a very real disability in a large percentage of the soldiers, rendering them temporarily or permanently unfit for active service. But the use of cardiac terms in describing the condition is baneful because it conveys an impression both to patient and to medical officer which is not justified by our present knowledge. It conduces to over-anxiety on the patient's side, to unnecessary precaution on the officer's side. No man who is retained in the Army should be allowed to believe that his heart is weak; no man who is retained for duty should be classed under either one of these categories of sickness. It is a first task in treating the patients under consideration to persuade them of the truth, to bring home to them the fact that their hearts are really sound. Their demonstrated capacity to exercise helps to persuade them; but in an appreciable proportion of cases they have become so thoroughly imbued with a wrong idea that no statement or demonstration will convince. The Army terms form a barrier to successful treatment. It is being said by civilian



practitioners that heart disease is on the increase. Supposed heart affections have indeed multiplied, the terminology manufactures them ; real heart disease is no more and no less frequent than it was.

*The future of prognosis.*

It has been said, and said repeatedly of recent years, that the medical profession has neglected prognosis. In a measure, and in a large measure, that is true. But the onus does not lie wholly, or even in chief part, upon the profession. General practitioners could perhaps accomplish much by steady and careful observation ; especially could they do so in the smaller towns where the population is relatively stable. But how many practitioners possess sufficient reserves of energy when their routine tasks are done to record with requisite care the observations of the day ? In larger centres the task of watching patients year by year in sufficient numbers is almost hopeless. The discouragement which the hospital physician meets, which many have met over and over again in attempting to obtain after-histories, is well-nigh heart-breaking. Of a hundred letters sent to old patients, perhaps a third, or may be less, is answered. Such a percentage is often useless, and innumerable records carefully compiled and kept are rendered valueless from this standpoint ; for a large percentage of replies is usually essential to exactitude.

Yet if medical prognosis is to be placed on a sound basis, after-histories we must have ; furthermore, not only prognosis but the development of diagnosis and of treatment are intimately dependent upon this method of research. After-histories are imperative. They have been the very essence of the work conducted on heart cases in this military hospital, and to them we owe in chief measure our confidence in our system, nay more, the system itself as it now stands.



Our after-histories have been reliable because we have obtained so large a percentage of replies to our inquiries ; for that we are indebted to the unfailing courtesy of officers in the service, when our old patients have remained under surveyance, and to the men themselves when these have left the service.

The coming days of peace will offer an unprecedented opportunity to our profession. Tens of thousands of young patients have come under observation and will remain under observation for many years or for the rest of their lives. These men will come at intervals before the pensions boards. A little foresight, a little control, and a mass of information of a valuable kind can be collected, sifted, and turned to good purpose. The State can ensure one return for what it pays : it can obtain a wealth of knowledge.



## APPENDIX.\*

## MEDICAL REPORTS ON DISCHARGED SOLDIERS.

ARMY FORMS B179A AND Z22 AND PENSION  
FORM A<sup>36</sup><sub>C</sub>.

The construction of answers in these forms is one of the most responsible tasks which falls to the lot of the medical officer in charge of the case and of those who sit upon the discharging and pensioning boards. Upon the correctness of the return depends the fair treatment of the discharged soldier and the expense involved by the State. Hasty returns on the Army forms entail endless trouble to the pension boards and seriously cripple the efficiency of their work ; in the future they will entail serious hardships to individual men, and serious and unnecessary inroads upon the public purse. The State can afford to give and to give generously to the men who have served it, but the amount which can be given has a limit and it is the duty of the medical profession to see that it is justly distributed ; the system of distribution should be as uniform as possible.

I propose here to discuss some of the more important considerations which must be weighed by medical officers before they can efficiently fill these forms, confining myself to the cases classed in the "heart" group. It will be

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\* This Appendix has been submitted before publication to the proper authorities, and their suggestions have been embodied in it.



convenient to do so under the headings of the separate questions formulated.

*Question 11. "Date of origin of disability."*—In giving the date of the origin of the trouble in "*effort syndrome*" cases\* the date at which the first symptoms were experienced should be entered. In half the cases this answer will be "in civil life" with or without an actual date. The date of origin should be ascertained during the patient's stay in hospital and not after his discharge has been announced. A long history, as the men well know, makes for boarding as unfit; but the same history decreases the awards of the pension board. A dilemma of this kind stimulates a truthful answer. In cases of *mitral stenosis* the onset of symptoms may be used, providing that the symptoms started in civil life. If the symptoms arose during the period of service the answer is more difficult to give. It may be taken that an early mitral stenosis is of at least three years standing, that a fully developed stenosis is of at least five years standing. The condition develops very slowly. Stenosis fully developed in 1918 is a pre-war condition; early stenosis is not necessarily so. If, therefore, there is no account of rheumatic fever or chorea in the civil history, then the benefit of the doubt should be given to the man in an early case, and the date should be entered for the war period; but if there is a rheumatic history dating shortly prior to enlistment, the mitral stenosis may be presumed to have originated at that time. The medical officer is on his safest ground when in early cases a history of rheumatic fever antedates the board by three or five years and when in fully developed cases the rheumatic fever antedates the board by some five or ten years. In *aortic disease* the estimate of date of origin, when the symptoms do not antedate enlistment, should be given as the

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\* "*Effort syndrome case*" and "*D.A.H.*" may be read as synonymous for pension purposes.



date of rheumatic fever or syphilis in the history.\* But if, as often happens, there is no such history of infection and the symptoms are of recent origin, then the decision should go in the man's favour and a recent date should be entered (onset of symptoms). As opposed to mitral stenosis, aortic defects often develop quickly in rheumatic disease. Similar considerations apply in the case of *cardiac enlargement* and of *arterial disease* and *aneurism* as in mitral stenosis and aortic disease, in judging the date of origin of the disability. *Serious disturbances of rhythm* should always be dated from the first onset of symptoms.

*Question 13. "Give concisely the essential facts of the history of the disability, etc."* This question is usually answered with unfortunate brevity. In "heart" cases it should always contain: (1) a note on the man's capacity for exercise, games, work in school life or at any other relevant dates prior to enlistment; (2) a full statement with dates of relevant infections; (3) date of enlistment; (4) length and tolerance of training and its type; (5) length and character of duty performed; (6) a brief history of symptoms with a note on any event to which the symptoms are dated.

*Question 14.† "State whether the disabilities are (a) attributed to or (b) aggravated by — (i) service during the present war; (ii) previous active service; (iii) climate in pre-war service;‡ (iv) ordinary military service before the war; or (v) serious negligence or misconduct on the man's part."*

The answers to the questions under (a) should conform to those to question 11, already considered. If the origin

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\* A positive complement fixation test in an aortic case usually indicates old-standing disease of the aorta, usually of not less than five years standing, if the aortic disease is judged to be syphilitic.

† Question 10 of form Z22 should be answered similarly.

‡ Military service abroad and before August, 1914.



of the condition dates from rheumatic fever, gassing, etc., it should be stated clearly. The only entry which can occur, except quite rarely, under (v) is a history or sign of venereal disease; such a history, as we have seen, is relatively uncommon in military "heart" cases; and in syphilitic disease of the heart, the disease is usually long-standing. Under (b) the answer is usually to be given in the affirmative, for almost all "effort syndrome" cases are aggravated by service (exceptions are most frequent amongst cases of the constitutional type, in which service has been of short duration and the duties light), and most cases of real heart disease have also to be considered aggravated unless the term of service has been quite short.

*Question 14 (a).* "If not due to any of these causes, to what specific condition do you attribute it?" The answer should be: (1) "not applicable" where the disability is due to one of these causes; (2) "constitutional" where the disability has arisen gradually or from uncertain causes in civil life; or (3) name the infection or other event from which the symptoms or lesion are stated to have arisen.

*Question 15.\** "What is his present condition?" The observed symptoms, the size of the heart, the presence of thrills or murmurs, the presence of a grave irregularity should be noted, and in all instances a note should be made on the observed tolerance of exercise. Signs of failure of the heart should also be noted if present.

*Questions 21-22 (a)* are answered by the discharging board on the same lines as the answers given to questions 15, 14 and 14 (a) by the medical officer.

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\* Question 2 of form A <sup>36</sup>/<sub>c</sub> (Pensions) should be answered similarly. In answering the question the disability for which the pension has been granted should alone be described.



*Question 23.\** “*Is the disability in a final stationary condition?*” The answer to this question in “heart” cases is almost always in the negative. The question continues—“*If not—(a) How long is the present degree of disability likely to last?*” In all structural heart cases the answer is “permanent.” In the remaining cases the answer should be “six,” “nine” or “twelve months.”† (b) *If the present degree of disability is not likely to last twelve months, can a further assessment at a reduced rate be made, etc.?*” The answer for “heart” cases should be in the negative. All “heart” cases in which the duration of the malady is considered temporary or uncertain should come up for re-examination.

*Degree of disablement.*

*Question 24 (a).‡* “*What is the degree of disablement at which, in the board’s opinion, he should be assessed at present, independent of hospital or other treatment? (Degrees of disablement should be expressed in the following percentages : 100, 80, 70, 60, 50, 40, 30, 20, less than 20, or nil.)*”

In answering this question there are two considerations : The first is an estimate of the man’s actual physical capacity for work without distress ;|| the second is the advisability of his engaging in such work ; thus a man may have the strength to accomplish a task, but his condition may be such that the work endangers his health or his life.

\* Question 3 of Pension form A <sup>36</sup>/<sub>c</sub> and question 11 of Army form Z22 are answered on similar lines.

† Whenever possible one of the longer periods should be entered ; in entering a longer period in an “effort syndrome” case, the total disability may be reduced by 10 per cent. in the average for anticipated improvement.

‡ Question 4 of Pension form A <sup>36</sup>/<sub>c</sub> and question 12a of Army form Z22 should be answered on similar lines. The information required is in respect of *total* disability (including the disability on joining the Army).

|| The basis of the estimate is to be the “man’s physical capacity as compared with that of the ordinary healthy man of the same age. It does not vary simply with his earning capacity, since pension is not merely a recompense for impaired power of earning a livelihood, but is also a compensation for loss of the amenities of life.”



“ *Effort syndrome.* ”—The physical capacity of such cases as are discharged permanently unfit from the Army is reduced by an amount which may be computed from actual observations on the exercise tolerance of such patients while in hospital, and from the amount and character of work of which they are capable on returning to civilian life. When a complete group of “effort syndrome” cases is considered, it is found that 50 per cent. of the men are discharged as unfit within twelve months of their first admission to hospital. The exercise tolerance of the men is very variable. On leaving hospital it is gauged as normal or reduced insufficiently to depress materially their value in the labour market in 20 per cent. ; it is reduced to the extent that there is appreciable difficulty in taking five-mile route marches and in doing stiff thirty-minute exercises in the next 30 per cent. ; it is so reduced as to render the men incapable of such marches and exercises in the next 30 per cent. ; it is reduced so that anything but very light physical work is precluded and so that there is discomfort in walking one to two miles daily in the last 20 per cent. in the average ; from these observations we may gauge the *disability* of the groups discharged as permanently unfit (namely, the last 30 per cent. and 20 per cent. of the whole) as not far short of 40 per cent. and 60 per cent. respectively.

The capacity for work as judged by return to occupations forms a serviceable check to the observed tolerance in hospital. In a group of 97 men discharged unfit as “D.A.H.” cases only 8 were unoccupied less than nine months later, and this by reason of ill-health. The average working hours of the group, according to the men’s own statements, was 40 hours per week, or almost six seven-hour days. Now it is true that in this period of nine months there had been improvement in the health of some of these men ; but, according to their own statements it had been only slight ;



such improvement as occurred being largely attributable to return to the home life and to the removal of the threat of duty overseas. Despite these relatively good hours, however, the capacity for work was clearly reduced. The seven-hour day is not to be compared with the eight-hour day of the heavy trades. The men worked for the most part in light or sedentary occupations, and there had been a good deal of movement towards lighter work amongst them. The character of the work before and after serving is shown in the accompanying table :—

TABLE XIX.

*Numbers of men engaged in work of different grades. (Year 1915.)*

<i>Work before serving.</i>					<i>Work after serving.</i>				
27 heavy	..	..	..	..	{	7 heavy			
						8 moderate			
						10 light or sedentary			
						2 none			
27 moderate	..	..	..	..	{	1 heavy			
						11 moderate			
						13 light or sedentary			
						2 none			
43 light or sedentary	..	..	..	..	{	1 moderate			
						38 light or sedentary			
						4 none			
<hr/> 97						<hr/> 97			

Men originally in heavy employments pass in the main into lighter employments; so do those originally on moderately heavy work, though to a lesser extent. Amongst the men originally employed on light or sedentary work the capacity for work is but little changed by their term of Army service. The hours of work are of chief importance in showing that the amount of work given by them in the service, before they leave it, is to an extent an unreliable index of their capacity. A man from whom the Army can obtain only an hour's work will work seven the moment he is subject to the wage-earning stimulus.



The disability is to be judged in "effort syndrome" cases on physical capacity alone. The employments which the men take up do them no injury; on the contrary, they are beneficial, as evidenced by the improvement, slight though it be, in the group as a whole. Inquiries have clearly elicited the fact that there is improvement. The actual replies received from 104 (out of 109) men questioned within nine months of discharge may be tabulated:—

TABLE XX.  
*Symptom change after discharge.*

Very much improved	..	..	..	4
Much improved	..	..	..	8
Slightly improved	..	..	..	30
Unchanged	..	..	..	56
Slightly worse	..	..	..	4
Decidedly worse	..	..	..	2

We have seen very remarkable improvement in isolated instances, in men coming to report themselves, but in the group as a whole it is no more than slight.

The *disability* in "effort syndrome" cases with fair exercise tolerance may be fairly placed at 20 per cent. and in those with poor exercise tolerance at 30 to 40 per cent. Exceptionally it may be placed as high as 50 or 60 per cent. in cases where development is poor or where a history of rheumatic fever is given. The group showing poor exercise tolerance is the only group which should, but is not the only group which will, come before invaliding and pension boards to any extent until demobilisation begins. *In the average*, the assessment of the disability at the first re-examination of the pensioners should decrease by some 10 or 20 per cent. if this re-examination occurs at the end of nine months, for during the first nine months health will improve.

*Mitral stenosis.*—In early and uncomplicated cases of mitral stenosis (by which I mean stenosis of such degree that the characteristic murmur is present on occasion only, or



only on lying or after exercise) the exercise tolerance is often quite normal; many men with this valvular defect have spent months on front line work, have been in heavy fighting and have been little the worse for it. In early cases there is usually no reduction of physical capacity for work, but all such cases run considerable risk when engaged in heavy work and it is not advisable that they should be so engaged, despite good exercise tolerance. A developed mitral stenosis, even if the exercise tolerance is good, is a serious defect, the prospect of life is considerably reduced; such a lesion may be taken to indicate that the heart as a whole has been invaded; that is indeed the chief prognostic significance of mitral stenosis generally; the heart muscle is rarely sound. Where there is a developed stenosis, as indicated by a diastolic murmur or thrill constant in all postures, or where early stenosis is combined with poor exercise tolerance, the disability should be assessed highly (the detailed assessments are given in Table XXI). The other chief factors of significance in gauging the extent of disability are—enlargement of the heart, venous engorgement, and untreated fibrillation of the auricles. The presence of either of these three complications should place the assessment very high. If two or more are found in combination the disability is almost total. Fibrillation of the auricles is often the immediate precursor of heart failure in these patients; the failure may be warded off for some while by treatment and the disability temporarily reduced. As a general rule a mitral stenosis case which shows enlargement of the heart and venous engorgement is in a worse way than is a similar case in which untreated fibrillation is added. For in the last case the muscle of the heart is sounder, bearing as it does a greater burden, yet showing the same embarrassment.

*Aortic disease.*—Much the same considerations apply in aortic disease as in mitral stenosis. But aortic disease



is to be regarded as the more serious lesion, and I assess it 10 per cent. higher throughout. It is not to be forgotten that the base of the aorta and the coronary arteries are frequently involved. In some patients with aortic disease exercise tolerance is perfect; many soldiers have fought in the front line with this lesion and without mishap; some cases of aortic disease live to a good old age. But these are cases in which the lesion, as judged by the state of the pulse, is slight and in which there is no material cardiac enlargement or other complicating factor. The presence of a poor exercise tolerance is, as a rule, a clear indication of the seriousness of the lesion; the presence of much cardiac enlargement, of serious engorgement or of angina pectoris is ominous. In assessing aortic disease in the accompanying table I divide it into "slight" or "developed." By slight aortic disease I mean such disease as is evidenced by an early diastolic murmur at the base without there being any material alteration of the pulse. By developed aortic disease I mean full regurgitation with a collapsing pulse or aortic regurgitation with stenosis.

*Enlargement of the heart.*—Many soldiers discharged from the Army exhibit cardiac enlargement in the absence of a valve lesion or other obvious cause to account for it. Where such enlargement is more than slight (slight hypertrophy such as is indicated by a maximal impulse  $4\frac{1}{2}$  inches from the nipple line or definitely beyond the nipple in the 5th space), or when it is associated with poor exercise tolerance, the condition forms a serious disability. If untreated fibrillation is present, if a venous engorgement is added, then the disability is very similar to that found in similar cases in which mitral stenosis is also present; I mean to say that the addition of mitral stenosis to such a picture does not materially increase the disability.\*

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\* It is not stenosis of the mitral valve which chiefly disables, but the injury to the heart muscle which is associated with this lesion.



*Arterial disease.*—Thickening of the peripheral arteries is often local, and when local does not impair the capacity for work ; a given grade of arterial disease is of less significance as age advances. The chief symptoms of arterial disease, the chief disabilities to which it gives rise, are due to impaired nutrition of important organs such as the heart, brain or kidneys. In an arterio-sclerotic man, therefore, in addition to the exercise tolerance, the signs of an enlarged heart, of high blood pressure or renal involvement are those which chiefly gauge the degree of disablement. Signs of cardiac failure, with or without fibrillation of the auricle, may be present ; in such the condition is usually terminal.

*Aortic aneurism or grave angina pectoris* naturally involves very high grades of disability.

*Fibrillation of the auricles.*—This condition has been known to last for as long as thirty years, but in its presence the duration of life is rarely more than ten years. It is rarely uncomplicated. Standing by itself it should be the ground of assessing the disability highly. The actual capacity for work may be greatly increased by appropriate treatment.

*Auricular flutter.*—This condition is very rare in soldiers. It is only to be diagnosed with certainty by special forms of examination. Persistent flutter and fibrillation may both be taken to signify myocardial involvement. In assessing disability they may be treated alike.

*Paroxysmal tachycardia.*—When the attacks are mild and infrequent and the condition is uncomplicated (the usual picture) the disability is slight. More severe attacks debar the patients from heavy work, even though the attacks are infrequent, for such work will often provoke further attacks. Severe and frequent attacks prohibit heavy and moderately heavy work. In gauging these disabilities I treat the condition as uncomplicated by obvious cardiac lesions. If



# Medical Reports on Soldiers.

TABLE XXI.

Table of percentage disabilities.\*

<i>Effort syndrome</i> (with or without systolic apical murmur)							..	
With fair exercise tolerance	..	..	..	..	..	20%	or less	
With poor exercise tolerance	..	..	..	..	..	30-40%		
For history of recent or repeated rheumatic fever or for poor development	..	..	..	..	..	..	add 10%	
<i>Mitral stenosis</i>								
Early and uncomplicated with good exercise tolerance	..					30%		
Early and uncomplicated with poor exercise tolerance	..					50%		
Developed uncomplicated with fair exercise tolerance	..					50%		
Developed uncomplicated with poor exercise tolerance	..					60%		
Developed with enlargement	..	..	..	..	..	70%		
Developed with enlargement and venous engorgement	..					80%		
Developed with fibrillation (untreated) but no enlargement	..					70%		
Developed with enlargement and dropsy	..	..	..	..	..	100%		
<i>Aortic disease</i>								
Slight and uncomplicated with good exercise tolerance	..					40%		
Slight and uncomplicated with poor exercise tolerance	..					60%		
Developed with much enlargement	..	..	..	..	..	80%		
Developed with enlargement and engorgement or angina	}	..				100%		
Developed with enlargement and renal disease		..						
<i>Enlargement</i>								
Slight but definite with good exercise tolerance	..	..				20%		
Slight but definite with poor exercise tolerance	..	..				40%		
Moderate with poor exercise tolerance	..	..				50%		
Great with poor exercise tolerance	..	..				70%		
for untreated fibrillation or venous engorgement	..					add 30%		
for history of rheumatic fever (recent to repeated)						add 10%		
<i>General arterial disease</i>								
Uncomplicated with good exercise tolerance	..	..	..	..	..	20%		
Uncomplicated with poor exercise tolerance	..	..	..	..	..	40%		
With moderate cardiac enlargement	..	..	..	..	..	50%		
With high blood pressure	}					70-100%		
With grave angina pectoris								
With great enlargement								
With renal disease		..	..	..	..			
With venous engorgement								
With or without fibrillation								
<i>Aortic aneurism</i>	..	..	..	..	..	70-100%		
<i>Angina pectoris</i>	..	..	..	..	..	50-100%		
<i>Fibrillation of auricles</i> (or persistent flutter)								
Without signs of cardiac failure	}					50%		
With fair exercise tolerance and untreated		..	..	..	..			
<i>Paroxysmal tachycardia</i>								
Mild and infrequent attacks	..	..	..	..	..	less than 20%		
Severe and infrequent attacks	..	..	..	..	..	30%		
Severe and frequent attacks	..	..	..	..	..	50%		

\* This table of disabilities, originally formulated at the Sobraon Military Hospital, has been submitted for approval to the proper authorities before publication.



so complicated, paroxysmal tachycardia may be assessed on the same lines as fibrillation.

*Mitral regurgitation.*—This condition has been deliberately omitted from the table of disabilities. The diagnosis of regurgitation is uncertain; its cause when diagnosed is not easy to ascertain (see page 61). In itself it does not lower exercise tolerance or in any way disable. The assessment of the disability when regurgitation is thought to be present should be based exclusively on associated factors, such as exercise tolerance, enlargement of the heart, a history of rheumatic fever, recent or repeated, fibrillation, aortic disease, etc.. Where exercise tolerance is normal and there is no history of rheumatic fever no assessment is required. In cases which give a history of rheumatic fever and show a good exercise tolerance it may be wise to assess at 20 per cent. or less. Cases uncomplicated by enlargement, but showing only fair exercise tolerance, fall in the "effort syndrome" group and start with an assessed disability of 20 per cent.; if a history of rheumatic fever is present they obtain an extra 10 per cent., thus rising to the level of early mitral stenosis with good exercise tolerance. If slight enlargement is added to regurgitation, the assessment is from 20-50 per cent. (see "enlargement" group in Table XXI) according to the exercise tolerance and the presence or absence of a history of rheumatic fever. Consideration of the murmur itself is not only unnecessary in assessing, but would lead to endless difficulty in fair assessment.

*Question 24 (b).\** "In cases of aggravation or where there is any evidence that there was a disability on entry, what in your opinion was the degree of disablement which existed at the time of joining the Army?" The answer to this question should be expressed as a percentage. The chief points for consideration

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\* Question 12b of Army form Z22 is answered similarly.



in "effort syndrome" cases which have arisen before enlistment are (a) an estimate of exercise tolerance immediately before enlistment; (b) the effects of infection, shell-shock, gassing, etc., after joining, or any other event happening on active service which is known notably to aggravate. In cases of real heart disease arising before enlistment, aggravation may always be considered to have occurred where any material service has been given. Precisely the same points come up for consideration as in the "effort syndrome" group. In general, in a case of heart disease, the lowest percentage disability given for the diagnostic group to which the man belongs in the disability table may be taken as the *maximal* (though not necessarily the minimal figure) for the disability at *enlistment*. This is recommended because although a lesion, such as early and uncomplicated mitral stenosis or aortic reflux, may have passed unnoticed by the recruiting board\* such lesions, in the presence of complications, could scarcely have remained undiscovered. Thus, the complications may in general be viewed as "aggravation." Thus in a case of mitral stenosis arising in civil life the disability on enlistment should be placed no higher, though it may be placed lower, than 30 per cent..

Where there is uncertainty the benefit of the doubt should be accorded the man, and the original disability fixed at a low percentage. If, in arriving at the full disability, 10 per cent. has been added for poor development or for rheumatic fever *acquired before serving*, then it must also be added to the assessment of disability on joining.

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\* Being often in the pre-diagnosable stage.



## APPENDIX

### ON ROUTINE EXAMINATION OF THE HEART IN RECRUITS, ETC.

This appendix, written during the period of active warfare, is especially arranged to meet the needs of examiners of recruits for the Army ; but the same scheme is suitable in judging a man's fitness for national service of any kind. The same tests are recommended in gauging for pension purposes a man's capacity for work ; they may also be employed in estimating the fitness of hospital patients for work where a full exercise system is not available.

Each man should be subjected to certain simple but sufficiently drastic tests,\* and if he fails to pass satisfactorily through any one of these, he is not necessarily to be regarded as unfit, but may come under further and particularly close examination. The man stands at ease and stripped in front of the examiner. The examiner then notes in health the presence or absence of certain signs in quick and orderly succession. Looking at the man he sees his mouth closed, no pallor of the face, no blueness of the lips, cheeks or ears, no distension of the veins at the foot of the neck, little or no sign of pulse (venous or arterial) in the neck ; as his glance falls to the chest he sees no bulging of the precordium, and he notes the even and undisturbed rise and fall of the chest. These points are taken in almost at a glance, and unfailingly when the habit is for a short while cultivated. The examiner

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\* These tests of the cardio-vascular system are readily combined with those necessary to eliminate disease of the lungs.



places his whole right hand firmly on the precordium, and should note the approximate rate of the heart beat, its regular action, the absence of excessive or extensive throb or thrill. He defines the heart's chief impulse, and should find it, if it is to be found at all, *inside* the nipple line. He proceeds to percuss with a few quick strokes the left border of the heart's dulness and should find it inside the nipple line. He listens at the maximal impulse and notes the clear sounds of the heart while the patient holds his breath in expiration. He listens at the second right cartilage and at the second left cartilage and pays particular attention to the periods of early diastole, noting clear heart sounds and no trace of diastolic murmur while the breath is again held in expiration. He requests the man to lie, preferably with the head towards the light and slightly raised. He views the neck again and notes a leisurely filling of the veins and more or less pulsation in them; he glances again at the precordium and sees no excess of pulsation, feels it again, and listening to the heart sounds, hears them clear and unbroken. The man is next submitted to a simple exercise test and a normal reaction to this exercise is noted (see 12). The whole of these tests occupy but a few moments and if they are passed and no history of anginal pains (page 77), fainting or paroxysmal tachycardia (page 74) has been volunteered, the man may be passed provisionally as a fit man so far as the cardio-vascular system is concerned. If the tests are not passed, he is not necessarily unfit but should be subjected to further investigation, which is guided by what has been found.

1. *Pallor of the face.* If the mucous membranes are of good colour the sign may be passed over; if they are not, then the subject should be specially examined for aortic disease (page 68).

2. *Blueness, with or without distension of the veins* (see page 60). Men who have cyanosis, with or without



appreciable venous engorgement, will always display breathlessness and signs of distress on the simple test exercise. The liver may be examined for engorgement and the shins for dropsy.

3. *Excessive pulsation in the neck.* It should be determined if the pulsation is arterial or venous. Arterial pulsation is palpable, venous pulsation is but rarely so; arterial pulsation is greater in the erect than in the recumbent posture, with venous pulsation the reverse is true; arterial pulsation consists usually of a single thrust, venous pulsation is an oscillation. These two forms are often confused. If the pulsation is arterial the man is specially examined standing and lying for aortic disease; if it is venous he is examined for venous engorgement.

4. If the *rate of the heart* while standing is obviously high, it should be counted and the actual rate of fall taken at the simple exercise test.

5. If the *throb of the heart* is excessive or extends to several rib spaces or to the nipple line, or if the maximal impulse lies, as the examiner thinks, too far to the left, then particular attention should be paid to the size of the heart (see page 54).

6. *Disordered heart action.* If the heart is irregular in its action the *pulse* should be felt. An intermittent pulse or a coupled action may be neglected in itself (for exception see page 71), but calls for close scrutiny of the heart from other points of view. If the irregular action is of a less repeated type, the man should be asked to breathe deeply; if the irregularity follows the phases of respiration it may be neglected. If not, it should be noted if the action of the heart is regular immediately after an exercise test sufficient to raise the heart rate to 120 or more per minute. If it is not regular when rapid, then the irregularity is serious (see page 73).



*Slow heart action.* A heart rate at rest of less than 40 per minute is almost always a sign of unsoundness; if the rate is between 40 and 60 per minute, fitness should be judged on other physical signs and tests, or the subject should be referred for a special opinion.

*Rapid heart action.* A single observation of rapid heart action is never by itself a sufficient sign of ill-health in a man under 40 years of age (see page 22).

7. *Abnormal apical sounds.* If on listening at the heart's maximal impulse the first sound is very sharp and loud, if it is reduplicated, if there is an indefinite muffled sound preceding the first sound, or if a systolic murmur is present lying and standing and unrelated to respiration, the man should be examined by special tests for mitral stenosis (see page 70). If this is not found the unusual sound or the murmur may be neglected (for exceptions see 11). But it should be clearly understood that this neglect is only justified after a very thorough examination of the heart and after the exercise tolerance has been fully tested.

8. *Abnormal basal sounds.* A systolic murmur at the base of the heart, especially if it is harsh, suggests further examination and nothing more. A systolic murmur, maximal over the right upper cartilages, should direct closer attention to the condition of the pulse and to the period of early diastole; the heart's base should be felt for thrills. A systolic murmur, maximal at the left costal cartilage and accompanied by a thrill, should lead to inquiries as to transient cyanosis in childhood (pulmonary stenosis).

9. Those who are the subjects of aneurism will show clear physical signs or will fail to pass the exercise tests.

10. When the heart shows doubtful signs of enlargement, when there is excessive pulsation in the arteries or when



there is a ringing second aortic sound, special attention should be paid to the condition of the arterial walls and to the tension of the blood in the vessels.

11. The following abnormalities constitute the chief reliable signs of heart disease.\*

- (a) An aortic diastolic murmur.
- (b) Distinct over-distension of the veins of the neck (see remarks on page 60).
- (c) Definite signs of enlargement of the heart.
- (d) An irregular heart action which is maintained on exercise (the heart rate being high).
- (e) A diastolic rumble at the apex.
- (f) A basal or apical thrill. The thrill must be an unmistakable "purr"; a suspicion of thrill is insufficient.
- (g) Widespread arterial disease or a persistent† blood pressure, 180 or over in an elderly man, arterial disease or a persistent blood pressure of 160 or over in a young man.

A systolic murmur most audible at the apex is not a sufficient sign of disease, even though the murmur is harsh and constant in all attitudes. But if the murmur is associated with an unequivocal history of recent rheumatic fever (10 years) or occurs in a man of over 40 years of age, it is more difficult to overlook it.

12. If there are no clear physical signs of disease, judgment should form itself purely on the observed reaction to exercise. One of the first and most imperative duties of

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\* And are sufficient reasons for rejecting recruits as unfit for service without further examination.

† Persistent after ten minutes rest in the supine position.



every member of a recruiting, discharging or pensioning board is to make himself thoroughly conversant with the reaction of the body in health and in disease to physical exercise. For upon his knowledge of the untoward signs of these reactions the efficiency of his work will depend in very large measure. No man who has cardio-vascular disease of an immediately serious kind will pass the simple exercise test. Some few early cases of mitral stenosis and aortic disease will pass all exercise tests satisfactorily and can only be eliminated by physical signs; such men possess a relatively healthy myocardium. If there are none of those clear signs of disease above enumerated, and—

- (a) the reaction to the simple exercise is perfect, the man *may* be declared fit, but it is wiser to employ the strenuous test also;
- (b) the men are of sedentary occupation, or there are doubtful signs, such as questionable enlargement of the heart, or murmurs or sounds of doubtful origin,\* no man may be declared fit until he has passed both simple and strenuous exercise tests;
- (c) the exercise tolerance is only fair or poor, the degree of distress on the standard exercises is a measure of unfitness. In many cases where there are no clear signs of disease, the exercise tolerance is very poor; there is obvious distress on the simple test, with or without high pulse rate, and slow return of the rate to normal.

*Simple exercise test.*—The pulse is taken after the man has stood at rest for a few moments. The subject walks

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\* Examiners often waste a great deal of time over such signs and their discussion; such time is far more profitably spent in giving the men further exercise tests.



briskly down and up a flight of 40 steps and is immediately examined. The pulse in a healthy youth will not rise more than 10-30 beats per minute, and the original rate will be resumed within a half-minute or at the most two minutes. In older subjects the pulse reaction is less conspicuous. In health this exercise gives but little respiratory reaction. There is no sign of respiratory distress or expression of anxiety ; the man can answer questions without the breathing becoming noisy and without his sentences being broken or delayed by respiratory movements.

As an alternative to this test, hopping 20 times on the right and 20 times on the left foot has been suggested,\* the *shoulders* being raised 6-9 inches from the ground at each hop. The test is a little more strenuous than the last, and although it has the merit of being almost universally applicable, it has the defect of introducing the element of balance to an inconvenient extent.

A simple test may be found to be the only practical one for routine work ; it will eliminate the greater number of the defectives who pass the physical examination. But where doubtful signs of disease have been found, and where the simple exercise is passed, a more severe test is essential. It is strongly recommended that, whenever practicable, no man, otherwise deemed fit, should be declared fit before he is seen to perform strenuous work.

*Strenuous test.*—The *object* of this test is to produce the beginning of physiological distress. A weight of 20 lbs. (such as an iron bar or two 10-lb. dumb-bells) is raised from the floor to the full reach of the arms above the head at the rate of one lift in two seconds. A healthy man (aged 20-35)

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\* This test was adopted by the Ministry of National Service for recruiting purposes. Another equivalent test which may be conveniently employed is the following: The man places a foot on a chair and raises himself to the completely erect position upon it 20 times.



of sedentary habit, and to that extent "out of condition," can accomplish this lift 30-60 times without stopping, but at the end he will be "blown" and will show clear signs of breathlessness and fatigue; these symptoms will cause him to desist. Unhealthy men, "effort syndrome" cases especially, will show clear signs of distress when far less work has been accomplished.

The number of lifts is the gauge of the man's capacity for strenuous work; but the test is of what a man *can do*, not of what he *will do*. It is only to be used as a gauge, therefore, when signs of breathlessness or fatigue become manifest. It is particularly valuable when applied to men of sedentary habits and in doubtful cases of heart disease. If there is the smallest doubt about the soundness of the heart, a test of this kind is imperative; such a test will almost always bring a sharp and confident decision.

This test is only to be employed upon men who have passed a simple test satisfactorily.



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