made good so that a satisfactory balance may be maintained between blood concentration and ordinary excretion. To establish this approximately four pints of fluid should be taken daily. With sulphapyridine some clinicians have found jagged arrow-shaped crystals in the urine, with haematuria, pyelitis, and other signs of renal damage.

It is important, further, to see that the diet offered contains no sulphur; for instance, eggs are dangerous, as are other foods with a high sulphur content. For a similar reason magnesium sulphate and other sulphur-containing drugs are contraindicated. A good laxative for these patients, who are often constipated, is liquid paraffin or a simple enema. Treat the patient kindly, for a drastic purge may lead to intractable diarrhoea, with consequent dehydration and its unhappy results.

The following rough outline of treatment may be of value when dealing with some of the complications seen after administration of full doses of sulphapyridine:

Cyanosis.—This should not be taken too seriously. Do not withdraw the drug, but see that the diet is sulphur-free. Give 0.5 to 1 gramme of methylene-blue daily.

Retention of Urine.—Catheterize until bladder functions naturally.

Insomnia.—Chloral and bromide or pulv. ipecac. co. Paraldehyde or morphine only if urgently required.

Herpes Labialis.—Often seen in patients who have been given sulphapyridine in a crushed form. Soluseptasine ointment has been advocated, but has not proved satisfactory. Other more serious complications such as deafness, iritis or ophthalmia or other intra-ocular infections, synovitis, etc., require the specialist's attention.

From beginning to end a complete record of the treatment must be kept on A.F.I. 1237, giving the date and hour, the drug and dose administered, and the route of entry, and this document or a copy must accompany the patient if he is transferred from one medical unit to another, so that overdosage may be avoided. More particularly is this necessary when the transfer takes place from a small medical unit—for example, a medical reception station—to a general or isolation hospital.

Technique for the Intravenous Injection of Soluseptasine

It is advisable to have one or two orderlies present to steady the patient's arm, especially if he should be restless, resistive, or irrational. Choose the arm which appears to be furnished with the best veins. Extend the arm fully at the elbow. In applying the tourniquet round the upper arm leave one end in a loop instead of pulling it right through; thus when it comes to removing the tourniquet one tug of the free end will loosen the knot.

The soluseptasine (20 c.cm. of 5% or 10 c.cm. of 10%), previously warmed to blood heat, should be ready in the syringe, with all the bubbles of air carefully excluded. Wash the skin over the chosen vein with surgical spirit, penetrate the vein, withdraw a little blood into the syringe, release the tourniquet; then, watching the patient's face, slowly inject the solution. Withdraw the needle, place a thick pad of gauze over the site of puncture, and flex the arm. If the veins fail to fill satisfactorily on applying the tourniquet repeated flexing of the arm at the elbow will bring about the desired result. Should it prove difficult to insert the needle into a vein, another vein should be chosen, perhaps on the other arm, but care should be taken not to "blow up" the vein.

I wish to give full credit to the excellent and untiring professional care and ability shown by the medical and nursing staff of this hospital, and thanks to Lieut.-Colonel Little, O.B.E., the Assistant Director of Pathology, Aldershot Command, who has done all the pathological investigations, and to others for their kind co-operation.

EXAMINATION OF THE HEART IN RECRUITS

BY

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The routine examination by the medical boards of many healthy young men called up for military service has brought into prominence various physical signs and symptoms referable to the heart. These are often slight, but their presence raises questions as to whether they can be ignored or whether they are important enough to justify the rejection of the man as unfit for service or his relegation to an inferior physical category. The following is an attempt to enumerate and to explain these signs and symptoms.

Cases met with in these circumstances can be divided into three groups:

1. The heart is normal in size and shape when examined radiologically; no symptoms are present, but minor variations in the heart sounds cause suspicion of disease.

2. The heart is normal clinically and radiologically, but the history or symptoms suggest present or potential effort syndrome or neuro-circulatory asthenia. These, if passed for full active service, are likely to break down and to become a prolonged and severe charge upon the community and upon themselves. An attempt should be made to pass the slighter cases for clerical or other non-violent work, or to find them official work similar to that which occupies them in civil life.

3. Exercise tolerance is normal, but physical abnormalities of the heart, either congenital or acquired, are detected. The diagnosis of the commoner congenital abnormalities is described and an attempt is made to indicate the manner of dealing with the organic cases.

I. The Normal Heart without Symptoms

Excitable young adults at the time of a medical examination often have an excessive sympathetic tone, presumably largely due to an increased output of adrenaline. One result of this is a transient glycosuria, but other manifestations are found in the cardiovascular system. The heart rate is increased, often up to 120 or more. The muscular thrust of the apex of the left ventricle is abnormally vigorous. This produces several physical signs, each of which may suggest a cardiac abnormality. On inspection the impulse extends into two or more spaces and may be visible in the epigastrium. On palpation a false impression of enlargement may be obtained in the following way: The vigorous impact is transmitted by the rib to a point outside the true apex beat; therefore when the hand is placed over a rib rather than in a soft interspace a false conclusion is arrived at. In determining the point furthest to the left and furthest downwards where the heart action is felt great care must be taken in these cases to locate it with the finger-tips in the soft interspace.

Another abnormality produced by overaction of the normal heart is an impurity of the first sound. This change may be so definite as to suggest a short presystolic murmur. The chief points upon which to fix the attention are the pitch of the sound and the absence of any early sound in diastole. In mitral stenosis the pitch is high, like that of a drum stretched tight, but here the pitch is low, like that of a looser and more booming drum. Moreover, in the vast majority of cases of mitral stenosis a mid-diastolic murmur is audible after exercise with the patient lying on his left side.

An associated nervous increase in the blood pressure is found in some of these cases. The increase is presumably due chiefly to increased output, and thus,

although the systolic reading is temporarily raised even above 170, the diastolic is little if at all changed. No cardiac enlargement is present in these cases of transitory nervous spasmodic hyperpiesis, and subsequent readings with the patient at rest show progressively lower readings.

In some hearts, normal in size, shape, and function, a third heart sound is audible at the apex in mid-diastole. This has to be differentiated from early mitral stenosis, from early heart-block, and, if some doubt as to timing exists, from a bundle-branch defect. This third heart sound is a normal phenomenon. It varies with respiration, being loudest in expiration or in very early inspiration, and it is associated with a normal low-pitched first sound. It is commoner with a low heart rate and disappears in tachycardia. In early mitral stenosis, on the other hand, exercise is likely to accentuate the diastolic murmur and even to bring out a hitherto latent presystolic murmur. Moreover, radiological screening examination, which is essential in these doubtful cases, will nearly always show more or less cardiac enlargement if mitral stenosis is present, particularly of the conus pulmonalis and of the auricles, and, in the right lateral position, a backward displacement of the oesophageal barium shadow due to enlargement posteriorly of the left auricle.

Early heart-block is seen sometimes in patients who are now healthy but who sustained rheumatic disease of the bundle of His at some previous time. No beats are dropped, but the prolongation of the auriculo-ventricular interval dissociates slightly the auricular from the ventricular systole. Here the auricular contraction may be audible in late diastole. This condition is rarely found in young adults except in conjunction with other stigmata of rheumatism, such as cardiac enlargement or mitral disease. Its presence proved electrocardiographically would necessitate a very careful review of the individual case. A congenital abnormality of the branches of the bundle of His occurs rarely. Here there may be a reduplication of the first sound. Accurate diagnosis is impossible except by electrocardiograph tracings. In most cases it is possible, by timing the heart sounds with the carotid or with the apex beat, to prove that the reduplication involves the first and not the second sound. If these patients enjoy a normal exercise tolerance and have no symptoms, and if there is no enlargement of the heart, the congenital bundle-branch defect can be ignored.

In addition to these variations in normal heart sounds certain murmurs or adventitious sounds may cause difficulties in diagnosis. Systolic murmurs of various types are the commonest of these. The statements that follow refer to systolic murmurs which do not have the easily recognizable characteristics of classical mitral regurgitation, aortic stenosis, patent ductus arteriosus, intraventricular septal defect, or pulmonary stenosis. They refer to murmurs which are localized or which have unusual directions of conduction.

The best tests of the organic basis of a systolic murmur, whether the underlying lesion be congenital or acquired, are the effects of posture and of respiration. If a systolic murmur is entirely absent in the erect position it is unlikely to be organic. If it is present only in the erect position it is almost certainly functional in type. Again, if a murmur is completely absent at certain phases of respiration, most usually full inspiration, it is unlikely to have an organic basis. The cardio-inspiratory murmur, described later, is a functional murmur having the opposite characteristic—that is, it is absent during expiration and is heard only during inspiration.

The following are examples of functional murmurs encountered in recruits in whom no other cardiac abnormalities were found.

(i) A soft systolic murmur was audible at the apex and conducted to the pulmonary base. It was absent in the erect position.

(ii) A systolic murmur, rather soft and blowing in character, was heard at the apex. It was conducted out into the axilla and up to the pulmonary base. It was present in the erect but loudest in the recumbent position. But it was audible only during inspiration and was entirely absent during expiration. This was an example of the common cardio-inspiratory murmur often found in thin young adults. The cause is obscure.

(iii) A rather loud systolic murmur was present in the fourth space, to the left of the sternum. It was localized at this point and was absent in the erect position.

(iv) A rather rough systolic murmur was heard at the pulmonary base. This was absent in the recumbent position.

(v) A loud squeaky systolic murmur was present in the fourth left space near the sternum. It was conducted up towards the pulmonary base and half-way into the axilla. It was much louder in the erect position, but was still audible when the patient was lying down. In the latter case, however, it became completely absent during early inspiration for a few cycles. It was far louder during expiration, especially at the end of this. It had the harsh character, almost a friction sound, which has caused the adjective "exocardial" to be applied sometimes to this type of sound.

II. The Normal Heart with Symptoms. Neuro-circulatory Asthenia

This condition is the commonest cause of cardiovascular breakdown under the strain of active service. Since there is usually no clinical evidence of cardiac disease, such as enlargement of the heart or auscultatory abnormality, the detection of cases likely to develop it is difficult. In the majority of cases there is no history of nervous breakdown or of gross psychological disturbance, but the individual is often of a "highly strung," repressed, and reserved type. He is frequently a non-smoker and a non-drinker with unusually fastidious ideas regarding the details of his mode of life. The significant positive findings in the past history of such cases are palpitation, discomfort in the left chest when tired, a tendency to faint, giddiness, undue sweating, and nervousness. A previous history of "a nervous breakdown" is significant when present. On examination the man may be obviously strung up and nervous, and his expression manifests suspicion. He may be abnormally pale from generalized superficial vasoconstriction. There is considerable nervous tachycardia and the action of the heart is forceful and slapping. The exercise-tolerance test is nearly always unsatisfactory: good figures are hardly ever obtained. The resting rate may have been 90, but after running up one flight of stairs the rate rises to 160 or 180, and remains high—at 120, for example—after he has been resting on a couch for five minutes. It must be remembered, however, that many perfectly normal recruits have a considerable nervous tachycardia and even unsatisfactory exercise-tolerance figures, but these normal men have played games with enjoyment or have been employed in heavy physical work without any untoward symptoms whatever. If a careful history reveals this symptomless and satisfactory exercise tolerance the experimental figures can be disregarded.

On physical examination other signs suggesting the presence or the future possibility of the effort syndrome are tenderness to firm palpation over the apex beat or even over the third, fourth, or fifth left intercostal space, and a labile vasomotor system. Signs of the latter can be elicited by taking the pulse and blood pressure lying, and then after the patient has been standing for three minutes. Normal figures would be as follows:

	Lying	Standing
Pulse	72	72
B.P.	120/70	125/72

Figures indicating poor vasomotor control would be:

	Lying	Standing
Pulse	78	100
B.P.	124/76	106/68

The following is a typical case.

A man aged 21, an advertising designer, had always lived a sheltered life. It appeared that he had never had rheumatic infection, but had been in bed for four months with kidney trouble at the age of 10. For the year preceding his examination he had complained of palpitation on exertion, slight discomfort over the left pectoral region, especially if tired, and an increased tendency to sweating and flushing. On examination the heart was found to be normal in size. The first sound was not quite clear, and a classical cardio-inspiratory murmur was audible at the apex and conducted into the left axilla and to the pulmonary base. He was not recommended for active service, but it was stated that if his drawing ability could be of use he could be accepted for a sedentary or partially sedentary post.

III. The Abnormal Heart without Symptoms

The third and final group consists of men who have a physical sign which proves or suggests the presence of organic disease but who, in spite of this, have no symptoms. Many such men are potentially useful in military service, but certain considerations have to be borne in mind. If a man knows that he has a cardiac murmur he has a very useful peg on which to hang imaginary symptoms if he should wish to evade dangerous or unpleasant military duties, or if he should wish in after years to lay claim to a pension. A man with a congenital cardiac defect is a little more liable to the risk of developing a superadded infective endocarditis as a result of prolonged stress, fatigue, and exposure to weather. A man who has once had rheumatic carditis is definitely more liable to a further attack, and even though the first attack has left him with a well-compensated slight valvular defect, there is no guarantee that the second attack will prove so innocuous.

In assessing the suitability of a man for service there are therefore two possible points of view: either no risk at all is taken and every man with an organic lesion, congenital or acquired, is rejected, or an attempt is made to ensure that such men when accepted for service will not be exposed to the factors likely to be dangerous to them individually. In the former case the country may be saved some money in pensions, but in the latter case it will be strengthened by useful man-power of which it would otherwise be deprived.

The physical signs of acquired heart disease need no description here. But congenital heart disease is so comparatively rare that the signs of the commoner varieties of the non-cyanotic group are recapitulated. Congenital disease with cyanosis and clubbing is so obvious that cases will be rejected on the most cursory examination.

There are two congenital lesions which produce definite signs, but which usually occur without symptoms and which may cause difficulties in diagnosis. These are patent ductus arteriosus and patent interventricular septum. Patent ductus arteriosus produces a flow of blood from the aorta to the pulmonary artery which is greatest during systole but which extends into diastole. In proportion to its degree this causes more or less of a leak from the arterial system, so that, as in aortic regurgitation, there are found excessive arterial pulsation, a lowered diastolic pressure, and some hypertrophy of the left ventricle. The signs are as follows. A systolic murmur, often with systolic thrill, is heard loudest in the second and third left

spaces near the sternum. In some cases this murmur is prolonged into diastole and in a few cases it is a continuous murmur with a systolic reinforcement. Left ventricular enlargement is present in proportion to the extent of the lesion, as is a lowering of the diastolic pressure. Radiological examination shows a typically prominent pulmonary conus and pulmonary artery.

Patency of the interventricular septum is shown by a systolic murmur, harsh in character, often accompanied by a thrill, and heard loudest in the fourth space near the sternum. This is present in all postures and at all phases of respiration. Clinical enlargement of the left ventricle is absent if the lesion is slight, but in severe cases it is present. Radiologically, in the latter cases the enlargement of the heart is general.

The following are brief descriptions of cases illustrating these points.

Case 1.—A man who had always been well and who had played vigorous games was found to have a systolic thrill and a systolic murmur, best detected in the fourth left space near the sternum. The murmur was so loud that it was conducted radially from this area, being audible half-way into the axilla and up to the pulmonary base. It was present in all phases of respiration. There was no cardiac enlargement. The cause was a small interventricular septal defect. The past history was so good and the general and cardiac health was so satisfactory that he was recommended for full service. Had the left ventricle shown definite compensatory hypertrophy this would have proved that the lesion was a considerable one. In such a case it would be unwise to expose the man to the full stress of service in the ranks. But even so, if a more sheltered Army job were available he could be passed for it. For example, he could safely be drafted as doctor to the R.A.M.C. or as a surveyor into the artillery, or as a clerk into the quartermaster's department.

Case 2.—A man who had always felt well, and who had played Rugby football until the last season, was found to have a systolic murmur and thrill in the second and third left spaces near the sternum. The systolic murmur was prolonged into diastole after the second sound. It was well localized. The apex beat was in the left mid-clavicular line in the fifth space. The murmur and the thrill were typical of a patent ductus arteriosus. Since there was no cardiac enlargement, and since the diastolic blood pressure was not lowered (130/70), it was clear that the leak was insignificant. He was therefore recommended for normal service. With a greater lesion there would have been an appreciable escape of blood during diastole from the aorta through the patent ductus to the pulmonary artery. This would produce changes analogous to those caused by aortic regurgitation, though usually less in degree. Thus left ventricular hypertrophy would be found, there would be an increased pulse pressure with a lowered diastolic reading, such as 150/60, and increased arterial pulsation would be seen. In such circumstances exposure to the full rigours of service in the ranks is inadvisable. These congenital defects do not cause heart failure, but they provide a nidus for an infective endocarditis, a condition found in the last war in susceptible soldiers on active service.

Organic Valvular Disease without Symptoms

The following were cases of organic valvular disease discovered in the course of examination in men who had not complained of any cardiac symptom. Mitral stenosis appears to be found less frequently in apparently fit men than aortic disease, for in the latter case the burden falls upon the left ventricle, which chamber is best adapted to meet the added burden of the lesion.

Case 3.—A man who had played football until eighteen months previous to examination had suffered from an attack of rheumatic fever nine years before. He felt well and had no symptoms. On examination the apex beat was half an inch to the left of the mid-clavicular line in the fifth space. When the patient was standing the heart sounds were normal except for a rather high-pitched first sound at the apex. When

he was lying this sound was higher in pitch and accentuated. A systolic murmur was present but not conducted, and also a mid-diastolic murmur localized to the apex. This was especially obvious after exertion. A well-compensated slight mitral stenosis was therefore present. This man would be unfit for any service exposing him to physical stress. In special circumstances he might be available for clerical or other fairly sedentary work. But any recrudescence of the active rheumatism might result in a heavy pensions liability to the country; for the subsequent illness might well be prolonged, with remissions, for fifteen to twenty years.

Case 4.—A man aged 32, 6 ft. 4 in. in height and well built in proportion, was found to have the murmur of aortic regurgitation. He had always been healthy, and had played games normally at school. On examination the presence of aortic regurgitation was confirmed, but the associated leak was insignificant. This was proved by two facts: first, the diastolic pressure was not lowered (126/72); secondly, there was little cardiac enlargement, the apex beat being in the fifth space and the orthodiagraphic diameter of the heart being only about 1 cm. above normal. This man had the definite promise of a surveying job in the artillery, for which he was fitted by his civil experience. He was therefore passed as fit.

Case 5.—A man aged 24 had had rheumatic fever two years previously. Since then he had worked as a coal-miner and had remained free from symptoms. On examination aortic regurgitation was found. Here again there was no significant leak, the blood pressure being normal (138/70) and the apex beat being in the fifth space in the mid-clavicular line. This man was rejected; for the risk of a second attack of acute rheumatism was greater since the first had been so recent, and he had no special qualifications which would enable him to be useful in a more sheltered job. Life in the ranks with exposure to weather and physical fatigue would provide too great a risk of another attack of acute rheumatism.

Case 6.—A man aged 26 had suffered from acute rheumatism at the age of 11. Since then he had been well, his recent work entailing heavy lifting in a timber yard. He had played games until the time of examination. He was found to have some hypertrophy of the left ventricle, the apex beat being forcible and just external to the mid-clavicular line. A systolic thrill was felt at the aortic base, conducted into the vessels of the neck. This was coincident with a similarly conducted harsh systolic murmur, also audible at the apex. An early diastolic murmur was present at the aortic base, and at the apex, indicating some aortic regurgitation. This was slight, for the blood pressure was not changed (152/80). Aortic stenosis was thus the significant lesion. The man was rejected; for, although he had no symptoms at the time, the thickening and calcification of the aortic valve cusps and the neighbouring tissue is progressive, and it is likely to affect the coronary circulation, producing angina of effort or unexpected death, especially after heavy exertion. If the man was likely to be of great use to the military authorities in some physically sheltered and skilled position it might be safe to pass him, but a definite risk would thus be undertaken.

Aids to Diagnosis

Very little mention has been made in the above paragraphs of the use of radiological and electrocardiographic aids to diagnosis. Many cases can be accurately assessed without these, but in all cases of doubt their help is invaluable. The x-ray screen is of use especially in the diagnosis of early mitral stenosis and patent ductus arteriosus, and it is an invaluable method of measuring accurately the size of the heart by orthodiagraph. This single observation is the most valuable of all in deciding the presence or absence of organic disease. Although a few exceptions occur, it may be stated that a heart which is not enlarged is organically normal, and, on the contrary, every enlarged heart is organically abnormal. In the examination of healthy young adults the electrocardiograph is more helpful in analysing irregularities than in estimating myocardial changes. Therefore it is of less practical value than the x-ray screening apparatus in this particular group of cases.

COLORIMETRIC STANDARDS FOR EMERGENCY ESTIMATIONS OF CERTAIN CONSTITUENTS OF BLOOD AND C.S.F.

BY

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The determination of urea in blood is most easily carried out by conversion of the urea into ammonia by urease, followed by direct Nesslerization; that of non-protein nitrogen (N.P.N.) and plasma proteins by suitable digestion with sulphuric acid, whereby the whole of the contained nitrogen is converted into ammonia, followed by Nesslerization. The resulting yellowish-brown solution is compared with a suitable standard in a Duboscq or photo-electric colorimeter, or in a photometer. Such instruments are not always available to the clinician or to the pathologist working under emergency conditions.

With the purpose of providing a simple means of estimating these substances without the use of elaborate apparatus artificial coloured standards for comparison have been investigated. Such standards should be indistinguishable in day or artificial light from the "Nessler-yellow" colour and should have a fair degree of permanency. To this end attempts have been made, first, to secure permanent suspensions of the yellowish-brown colloid produced with dilute ammonia and Nessler's reagent (these have not been satisfactory); and, secondly, to find a coloured substance or substances exhibiting a yellowish-brown tinge in solution which would appear sufficiently similar to most observers. Of the various substances tried a mixture of ferric chloride and cobalt chloride in hydrochloric acid solution has been the most satisfactory.

In the standards proposed the proportions and amount of ferric chloride and cobalt chloride have been so adjusted that the resultant mixtures have appeared indistinguishable from Nesslerized ammonia solutions in daylight and in artificial light. The comparisons have been made in test-tubes of standard bore (5×5/8 in.) viewed in a comparator block against frosted glass and in a test-tube rack against white paper. A standard ammonium chloride solution containing the equivalent of 0.01 mg. of N per c.cm. was employed as a basis for the comparisons. This solution was used in varying amount with added water and 1 c.cm. of Nessler's reagent in a total volume of 8 c.cm. This is the final volume of test and standard solutions in the micro-methods for blood urea, N.P.N., and plasma protein described by King *et al.* (1937), which are proposed for use with the permanent iron-cobalt standards. The numbers shown in the first column of Table I refer to the amount of nitrogen (mg. N) present as Nesslerized ammonia in the volume of 8 c.cm. which is the equivalent in colour of the stated quantities of iron chloride and cobalt chloride contained in the same volume.

The standard values have been chosen to represent the concentrations most often encountered clinically. They are so spaced as to represent increments of 0.005 or 0.01 mg. N, corresponding to 10 or 20 mg. of urea or N.P.N. per 100 c.cm. of blood. In the lower and middle range the values are spaced more closely in order to allow of more accurate estimation of plasma proteins. For total proteins the increments of 0.005 mg. N correspond to 0.78% protein. By careful matching intermediate values can be