INDEX.

PART I.

INDEX.

PART 2.

INDEX.

PULSE-PRESSURE IN HEALTH, WITH SOME NOTES ON THE INFLUENCE OF CARDIO-VASCULAR DISEASE.

INTRODUCTION.

The term pulse-pressure is applied to the difference between the systolic and diastolic pressure, and is expressed in terms of millimetres of mercury.

The object of this paper is to determine pulse-pressure in healthy men and boys; to enquire whether it is constant in the resting subject; and to note any differences at the various age periods. Further, attention will be directed to variations in pulse-pressure in healthy individuals under certain physiological conditions; and finally, some of the commoner diseases of the cardio-vascular system will be examined, and the pulse-pressure in these diseases will be determined, with a view to deciding whether, by comparison, any diagnostic significance can be attached to the latter. Many cases of heart disease are extremely difficult to diagnose with certainty, and any additional clinical sign which is reliable would be helpful.

But apart altogether from disease, pulse-pressure is referred to so sparingly in the literature, that it has been considered a useful experiment to determine such pressure in men, old and young, who are at least as healthy as any "first class life" among the civil population, and probably a good deal healthier.

This last remark is based on the fact that bluejackets and marines, (who form the vast majority of the subjects examined for the purpose of this Thesis) are "picked men", and are invalided from the service when they fall short of the high standard of physical fitness which is required of them. Further, they are medically examined as a routine at frequent intervals, both ashore and afloat, to this end.

This Thesis is not to study Blood-pressure per se, either in health or in disease. Pulse-pressure is, as it were, its offspring, and the terms bear, the one to the other, a mutual dependence.

It is not proposed to examine separately the two components of pulse-pressure, and to investigate possible influences on one or the other part, but rather to review the subject as a whole, and to draw what conclusions appear appropriate.

The records are in two sections, the first half is devoted to an investigation of pulse-pressure readings in healthy men and boys in various age-groups. Great care has been taken to examine only those subjects who are in undoubted good health; this has been made easier, in the case of the active service naval ratings by the scrutiny of their medical history sheets, (records of disease, to which the bluejackets may have been subject during their service) which are kept carefully with the man's service papers.

Some remarks on the reaction of pulse-pressure to exercise, etc., and other normal variations, are also included in this part.

The second part is devoted to the study of pulse-pressure in some cardio-vascular diseases, using the findings in Part I. as a basis for comparison.

The subjects examined, with the exception of those in the age-group 50 - 60 and boys of 9 - I4, are active service ratings. The older men (50 - 60 yrs) were mostly pensioners from the Royal Navy and Marines, employed at the several Naval Establishments in a variety of occupations i.e., gardeners, tailors, shoemakers. They of course, were medically examined before being engaged for such duties. The boys of 9 - I4 were selected out of a number examined medically at a School Inspection in Portsmouth. The pressures of those in good health and condition are included here. (Youths of I5 - 20 are Naval Ratings.)

The personal factor counts for a good deal in carrying out experiments of this kind, and it is necessary for the observer to rely on his own readings, and on them alone. The method employed, and the type of instrument, are equally important influences in blood-pressure estimations, and no change either in the one or the other has, therefore, been made during the observations under review.

METHODS USED IN THE INVESTIGATIONS.

The pressure readings taken for inclusion in this Paper, were made with a Baumanometer Sphygmomanometer (desk model) and the same instrument was used throughout. The width of the armlet was 12½ cm.

The auscultatory method of obtaining the systolic and diastolic pressures was used i.e., the air pressure in the armlet is raised until the radial pulse is obliterated, and the bell end of a binaural stethoscope is placed over the brachial artery at the bend of the elbow. (The artery in each case is accurately defined before the reading is taken, and the stethoscope placed on to it as it runs to the inner side of the biceps tendon) This point of auscultation should be 2 cm. below the armlet on the upper arm.

This part of the procedure is of the highest importance, i.e., the accurate fitting of the stethoscope over the artery, and the selection of a point close to the lower border of the armlet (2 cm). It can be shown by experiment, during the examination of any considerable number of men, that both systolic and diastolic readings may be made to vary within wide limits by not paying attention to either of these conditions.

In an investigation of this sort, therefore, the necessity of following closely these Principles will be appreciated.

Incidentally it may be remarked that the exposure of the whole upper arm from the shoulder joint is of importance. The habit of getting the patient to "roll up his sleeve," especially if he is wearing a shirt which is tight, results in a condition that may be likened to the partial occlusion of the brachial artery by a tourniquet. This makes an accurate reading impossible.

With the stethoscope in position, the armlet is deflated slowly until a point is reached where the blood can once more pass along the artery with each ventricular systole. This is indicated by a definite sound heard through the stethoscope, and which is distinctive: on hearing it, a glance at the mercury level will give the systolic pressure. Two, or even three, readings were taken in all cases to exclude influences such as excitement, or anxiety, and every effort made to get a normal "resting pressure". As the armlet deflates further, sounds similar to heart murmurs are heard, which give place to sounds less in volume, and finally to that distinctive phase where these sounds become suddenly faint and gradually die away. The diastolic pressure reading was taken at that moment when the distinctive faintness of the sounds is first obtained.

The readings were taken (except on occasions specified) with the patient sitting, his left upper arm encircled by the armlet, his muscles relaxed, and his attitude comfortable.

"RESTING" RECORDS.

The men examined, were called up for examination while they were going about ordinary duties; no preparation was made, except that those engaged in arduous duties involving hard physical labour were excluded for the time being, as the effect of exercise on pulse-pressure was investigated subsequently but at the same sitting.

In the same way, the time at which the examination was made was arranged so that it should be "between meals", as it was proposed to inquire into the possible alteration of pulse-pressure after a full meal.

The vast majority of cases were taken midway between breakfast and dinner: some of the boys were examined 2 - 2½ hours after the mid-day dinner. No alcohol had been taken during the day in these resting cases.

REACTION TO EXERCISE.

The reaction to exercise was carried out in the following manner; A wooden box, I6" high was put on the deck, and the man put his left foot on to it. Then he raised himself smartly, on his left until the right foot was on the box, twenty times in succession, afterwards changing feet and repeating the exercise. Both pulse rate and respiration were increased by this manoeuvre, but in varying degrees. The estimation of the pulse-pressure was made immediately after.

EFFECTS OF A MEAL.

The effect of a meal was investigated by first taking the resting pulse-pressure of a number of men an hour before their mid-day dinner, and repeating the observations half an hour or 40 minutes after the food was finished. Rum (3iij.) was taken in some cases, (noted in the table alongside the man's name.)

No heavy work had been performed by these men previous to the estimation of their resting pressures, in order that the latter should be disturbed as little as possible.

In each age-group a few subjects were found to exhibit signs of fright. The very word "blood pressure" to some of the men at least, conjured up visions of blood letting, or some such surgical procedure, and the mental unrest occasioned by the thought reacted on their cardio-vascular systems.

These men have been grouped by themselves as showing a variation from the normal pressures. Their condition was recognised by increased pulse rate, their facial expression, and their behaviour, (the majority were known to me personally) when they were being examined.

The number in each age-group who manifested this "reaction to emotion" was small. But the readings have been included in the lists as the results are interesting.

PULSE PRESSURE IN HEALTH.

At the end of this Thesis will be found a number of Appendices giving in the form of detailed lists, the results of the investigations undertaken.

It is proposed now to survey the records obtained by taking the resting-pressures of boys and men of various ages; (see the lists of pulse-pressures under the heading "Before exercise" in Appendices I to 6 inclusive), Appendix 7. gives a less detailed account of the systolic, diastolic and pulse-pressures in the same age-groups, compiled from the longer lists.

In order to facilitate easy reference, a more condensed summary is given below; it will be noticed that this includes all the pulse-pressures under review, with the systolic and diastolic pressures, in separate tables.

+ It has been pointed out by Sir Humphry Rolleston, that the age plus 100 represents the maximum systolic blood pressure, "which should not cause anxiety"; and that half the age plus 100 is "the most satisfactory healthy systolic pressure".

A perusal of the summarized systolic pressures in all the age-groups, given above, shows that the results are in accord with this observation.

SUMMARY OF PULSE-PRESSURES IN HEALTH.

Age group.	40-45.	46-50.	51-55.	56-60.	61-65.	66-70.
9-14.	82·5%	17·5%	-	-	-	-
15-20.	60·0%	30·0%	8·0%	2%	-	-
21-30.	56·0%	36·0%	6·0%	2%	-	-
31-40.	36·0%	50·0%	8·0%	6%	-	-
41-50.	10·0%	44·0%	32·0%	10%	4%	-
51-60.	-	-	7·5%	50%	40%	2·5%

SUMMARIZED SYSTOLIC PRESSURES.

Age group	100-109	110-120	121-130	131-140	141-150	151-160
9-14	42·5%	57·5%	-	-	-	-
15-20	2·0%	64·0%	34·0%	-	-	-
21-30	-	36·0%	60·0%	4·0%	-	-
31-40	-	18·0%	52·0%	30·0%	-	-
41-50	-	14·0%	22·0%	44·0%	20·0%	-
51-60	-	-	-	17·5%	65·0%	17·5%

SUMMARIZED DIASTOLIC PRESSURES.

Age group.	60.	61-70.	71-80.	81-90.	91-95.	96-100
9-14.	-	87·5%	12·5%	-	-	-
15-20.	2%	32·0%	66·0%	-	-	-
21-30.	-	8·0%	76·0%	16%	-	-
31-40.	2%	10·0%	42·0%	44%	2·0%	-
41-50.	-	6·0%	32·0%	58%	4·0%	-
51-60.	-	-	12·5%	85%	2·5%	-

AGE-GROUP 9 - I4 YEARS.

Before discussing the pulse-pressure of these boys, it might not be out of place to emphasise what has already been said in the introductory remarks, namely, that the boys were examined, during a School Inspection by a Medical Officer. The facility for obtaining pulse-pressure records in such young subjects, was kindly afforded by the School Medical Officer for Portsmouth, Dr.Roberts.

Each boy was physically examined before the blood-pressure observations were made, and he was weighed, and his height recorded. Thus general bodily fitness and good nutrition were assured in each case.

It will be seen by reference to the above summaries, (pages 8 and 9.) that practically all the boys had a pulse-pressure of between 40 and 45 m.m. a diastolic pressure of between 60 and 70 m.m. and a systolic pressure somewhat unequally divided between I00 - I09 m.m., and II0 - I20 m.m., the majority favouring the higher figure.

On the whole, if Appendix I. is consulted, the readings will be found very uniform; further, the boys took the examination with the Sphygmomanometer in the same calm manner as they assumed towards the rest of the Medical Inspection. Three only exhibited emotion of any kind, but within a minute or two their pulse-pressure had fallen to within the limits of the majority.

AGE-GROUP 15 - 20 YEARS.

In this age-group the vast majority of pulse-pressures (90%) lie between 40 and 50 m.m., further, 60% of these were found to be 40 to 45 m.m.,

If the systolic and diastolic pressures are examined separately, it will be noticed that 98% of the systolic pressures lie between 110-130 m.m., Of this proportion however, 64% are 110-120 m.m., a very considerable majority. Exactly the same percentage (i.e. 98%) of the youths show a diastolic pressure of 60 - 80 m.m., but 66% of these lie between the higher figures (71 - 80 m.m.,)

With regard to the 8% of boys having a pulse-pressure of 51 - 55 m.m., reference to the detailed Appendix 2. will show that this is due to an abnormally high systolic pressure and a "normal" diastolic pressure in two cases, (nos. 16. 25.) Two other cases, (nos. 31. 35.) have systolic pressures falling within the limits of the majority, but low diastolic pressures.

(The word "normal" is used above in the sense of the pressure being the usual, or most common, in this particular group.)

The one boy in this group with a pulse-pressure of above 55m.m. (No. 10 in Appendix 2.) has a combination of somewhat high systolic and lowish diastolic readings, the resulting pulse-pressure being, therefore, above the average.

It is apparent that the "normal" pulse-pressure of the boys lies between 40 - 50 m.m., for pulse-pressures, and that this was brought about by systolic pressures of 110 - 130 m.m., and diastolic pressures of 61 - 80 m.m. By far the most usual combination is a systolic pressure of 110 - 120 m.m., and a diastolic of 71 - 80 m.m.

AGE-GROUP 2I - 30 YEARS.

So far as pulse-pressure is concerned, there is little difference between this age-group and the last. A slightly larger proportion of readings lie between 46 - 50 m.m., with a corresponding decrease of those between 40 - 45 m.m. (Appendix 7. Table B. Page 67).

Analysis of the systolic and diastolic pressures shows a majority lying between II0 - I30 m.m., but in contradistinction to the last group, the greater proportion (60%) lie within the higher readings, (I2I - I30 m.m.)

Regarding diastolic pressures, the very great majority (76%) lie between 7I - 80 m.m. although a not inconsiderable number give readings of 8I - 90 m.m.

This undoubted preponderance of diastolic pressures in one column of the summary is a break-away from what was found in the last age-group, where a fairly large number were in the region of 6I - 70 m.m. (See Appendix 7. Page 66).

Respecting the 8% of men in this age-group who have a pulse-pressure of 5I - 60 m.m. it will be observed, on reference to Appendix 3. that numbers 5 and 9 have systolic pressures higher than is usual in the majority, but that their DIASTOLIC readings are well within the usual limits; numbers 6 and 39 reverse this, and show a "normal" systolic reading, and a diastolic figure below what is common in the group. However, the pulse-pressure is above the average.

AGE-GROUP 3I - 40 YEARS.

In this group, also, there is no marked difference between the two preceding age-groups in regard to pulse-pressure. The distribution of pressure of 40 - 45 m.m., and 46 - 50 m.m., is reversed, the bulk of men showing readings in the higher figures. There is also an increase (4% to 6%) of pulse-pressure readings between 5I - 60 m.m.

A large proportion (80%) of men have a systolic pressure of II0 - I30 m.m., but as in the last group, the great bulk lie between I20 - I30 m.m. (see Appendix 7. Table C.)

The diastolic readings are interesting, they are not so apt to favour one particular section at the expense of another; thus an almost equal number are found to be between 7I - 80 m.m., (42%) as to be 8I - 90 m.m. (44%) The "normal" for these men therefore lies between 7I - 90 m.m.

There is a slight increase of readings between 5I - 60 m.m. Reference to Appendix 4. will show numbers 8. 9. I0. II. I2. 28. and 33. so affected. Most of these owe the increase to relatively high systolic pressure; one case, only, No.8. showing a low diastolic pressure.

So far, then, pulse-pressure from 9 to 30 years of age, has been slowly increasing. The most frequent reading is from 40 to 50 m.m., and only in the age-group 30 - 40 years is a predominance of the higher figures found.

There is also a considerable jump in the number of men of 3I - 40 years showing a systolic pressure of I3I - I40 m.m., compared with the age-group 2I - 30, and a like increase in the diastolic pressure of 8I - 90 m.m.

AGE-GROUP 4I - 50 YEARS.

While it is not admitted that a man is "too old at forty" the figures in this age-group rather suggest a commencing change in the cardio-vascular system. It is generally assumed that this decade marks the beginning of degenerative processes, and probably a small percentage of men have already manifested these changes in their arteries, with alterations in their blood pressure readings.

Further, at this period of life those factors which are commonly regarded as powerful influences in the production of cardio-vascular hypertrophy and degeneration assert themselves. Metabolic products, toxins of subacute or chronic infections, (i.e. apical sepsis in connection with the teeth) and gastro-intestinal poisons, including those from latent cholecystitis, may be mentioned. But in addition, it must not be forgotten that often the individual has inherited a faulty vascular tissue; after forty years of age this will show definite pathological changes, and not infrequently, earlier in life.

Another influence, (at least, among these particular men) which should be mentioned is hard work under varying conditions, and in various climates, frequently adverse. In other words, from 4I - 50 years of age, the "wear and tear" of life, physical and mental, begins to tell.

It will be noticed in the summary of pulse-pressures (page 8.) that while a considerable percentage of men show a pulse-pressure of 40 - 50 m.m., the lower reading of 40 - 45 m.m., has been left with only I0%; and further, there are 42% with readings of 5I - 60 m.m. These latter it may be remarked, are men nearer 50 than 40 years old.

Four per cent of men have a pulse-pressure of over 60 m.m., and those with readings of 5I - 60 m.m., referred to in the last paragraph, all have systolic pressures above the normal for their age-group. (Appendix 5. Nos. 9. I3. I6. I9. 24. 38. and 46.)

Systolic pressures will be noticed to vary somewhat, although 44% are found in the column marked I3I - I40 m.m. The one next below, (I2I - I30 m.m.) claims 22%, and that just above, (I4I - I50 m.m.,) 2%.

Diastolic readings are more definitely stabilized, 58% being in the 8I - 90 m.m. section. So with the number in the column immediately preceding this, no less than 90% appear in the group 7I - 90 m.m.

The obvious comment on diastolic pressure at this age, would be that there is a decided tendency amongst men of 4I - 50 years to give the higher readings.

AGE-GROUP 5I - 60 YEARS.

If the remarks in the previous section regarding the incidence of early degenerative processes are admitted, it may be assumed that the men now under consideration will show more uniformly the results of such changes.

An examination of the summaries (Appendix 7. Table E.) does, in fact, reveal that 90% have a pulse-pressure between 56 - 65 m.m., 85% have diastolic readings of 8I - 90 m.m., and 65% of the systolic readings lie between I4I - I50 m.m., with an equal proportion immediately above and below. This is a remarkable increase on the figures for the preceding age-group. (4I - 50)

It may be said, in regard to the last two groups of men, that age has a definite influence on all three pressure readings - systolic, diastolic, and pulse; and that each, tends to increase.

Causes of increased blood-pressure, such as the several forms of nephritis, were excluded: The men were healthy, doing active work. If the factors which tend to bring about such variations in pulse-pressure as have been referred to are not all inevitable, it must be confessed that most are unavoidable, so far as the majority of people are concerned.

There results from increasing age, probably, definite cardio-vascular changes, although the arteries themselves, (temporal, brachial or radial), may not be palpable to the examining finger.

These changes are indicated by a blood pressure reading above the average for younger men, and varying somewhat according to the individual. But it would appear to be necessary to have a higher blood pressure in order to carry on the circulation efficiently, and this increase is an almost constant accompaniment of advancing years.

VARIATIONS OF PULSE PRESSURE IN HEALTH.

Having reviewed a series of observations on "resting" pulse-pressure in healthy subjects of various ages, some common circumstances, likely to affect pulse-pressure will now be considered.

Unfortunately the influence of sex is not included in this Thesis, because it was found impossible to examine a number of healthy females in age-groups. Certainly a few young girls and women could have been examined and their pulse-pressures recorded; but an investigation carried out in this manner would lose much of its value by the older women being excluded; for it is in these latter, that the influence of the menopause would be manifest; and this is a factor exerting extremely important effects on the cardio-vascular, as on every other system.

An extended enquiry of this scope, it was thought, could only be undertaken by a Medical Officer in Charge of a factory etc., where female employees of various ages come under his or her Charge; or by careful selection, in a general practice, of the healthy women seen from time to time. For it is obvious that changes in pulse-pressure may be expected in conditions other than cardio-vascular; and for this reason, every care should be taken to ensure that the subjects examined are in undoubted good health. It was considered that to omit altogether the influence of sex would be infinitely preferable to undertaking an imperfect investigation of the subject.

The common circumstances that might theoretically upset pulse-pressure are the following, each of the four being discussed on the subsequent pages.-

(I) Exercise.
(2) Food and Alcohol.
(3) Emotion.
(4) Two or three weeks confinement to bed in healthy subjects.

PULSE PRESSURE VARIATIONS IN HEALTH.

(I) REACTION TO EXERCISE.

If reference be made to the Appendices at the end of this Paper, it will be found that in numbers 2 - 5, there is a column setting forth the pulse-pressure in the various age-groups, after performing a set exercise, (the details of which have been referred to previously.)

The man under examination had his pulse-pressure taken immediately after the exercise, and in the same position as he assumed before.

Below is a summary showing the effects of exercise on the pulse-pressure of healthy men, compiled from Appendices 2 - 5.

Age group.	Pulse-pressures.		
	Raised.	Unaltered.	Decreased
I5-20.	90%	8%	2%
2I-30.	98%	2%	-
3I-40.	94%	2%	4%
4I-50.	82%	6%	I2%

(It was not convenient, owing to unavoidable Service conditions, to examine the "Exercise" pulse-pressure of men of 5I - 60, nor of boys of 9 - I4. But the above summary is considered representative.)

From this it is justifiable to say that in the very great majority of cases, the pulse-pressure of healthy men is raised after exertion.

But it is interesting still further to examine the lists, and to enquire into the behaviour of the systolic and diastolic pressures as determined after exercise, thus deciding the manner in which this increased pulse-pressure has been brought about.

With this object in view, a table has been prepared showing full details of the pulse-pressures and their component parts. For convenience, certain signs have been used to denote conditions of pressure, thus.-
+ means an increase, - a decrease, and the numeral o indicates "no change".
S denotes systolic, D diastolic pressure.
Each group will be reviewed separately.

AGE-GROUP I5 - 20.

Pulse-pressure	Cases	S+. D+.	S+. Do.	S+D-.	Total.
Raised.	45.	33.	4.	8.	45.
Unaltered.	4.	4.	-	-	4.
Decreased.	I.	I.	-	-	I.
	50.	38.	4.	8.	50.

In this age-group, although 45 cases showed a higher pulse-pressure after exercise, only 38 of these responded with an increase of both systolic and diastolic pressures. And of these 38 cases, four showed a resulting pulse-pressure equal to the resting reading, and one a decreased reading. Of the remainder, four responded with an increased systolic pressure only, and no less than eight with a decreased diastolic pressure, although the systolic was increased.

AGE-GROUP 21 - 30.

Pulse-pressure	Cases	S+D+	S+Do	Total.
Raised.	49.	45.	4.	49.
Unaltered.	I.	I.	-	I.
Decreased.	0.	-	-	-
	50.	46.	4.	50.

Here a much larger proportion showed both systolic and diastolic pressures raised. Only four cases failed to react in this way; they showed a raised systolic with a diastolic pressure unchanged.

AGE-GROUP 31 - 40.

Pulse pressure	Cases	S+D+	S+Do	S+D-	SoD-	S-D+	Total
Raised.	47.	36.	2.	8.	I.	-	47.
Unaltered.	I.	I.	-	-	-	-	I.
Decreased.	2.	I.	-	-	-	I.	2.
	50.	38.	2.	8.	I.	I.	50.

Although this age-group shows as many raised systolic and diastolic pressures as the youngest age-group, a more peculiar combination of pressures than has previously been encountered will be noticed.

There is one case each, for instance, in the columns marked "decreased systolic and raised diastolic", and "unaltered systolic and decreased diastolic" readings.

AGE-GROUP 4I - 50.

Pulse pressure	Cases	S+D+	S+Do	S+D-	SoD+	S-D+	S-D-	Total.
Raised.	4I.	33.	4.	3.	-	-	I.	4I.
Unaltered	3.	3.	-	-	-	-	-	3.
Decreased	6.	-	-	-	2.	4.	-	6.
	50.	36.	4.	3.	2.	4.	I.	50.

Here 36 men showed both systolic and diastolic pressures raised.

It should be pointed out that in this, the highest age-group examined, four cases responded with a raised diastolic, but with a decreased systolic reading; further, two more showed this increase in diastolic pressure, with an unaltered systolic.

Taken in conjunction with those in the last table, these raised diastolic with unaltered or negative systolic pressures, must be looked on as a definite reaction to exertion.

The inference to be drawn from this particular investigation would appear to be that physical exertion of a moderate kind definitely increases pulse-pressure at all ages in males between I5 and 50 years.

The majority of men examined reacted by an increase in both systolic and diastolic pressures; reference to the Appendices 2 - 5 shows that this increase was in various degrees.

In the minority are cases responding with unaltered or decreased diastolic associated with raised systolic pressure; and some other unusual combinations of these pressures are scattered throughout the series.

Thus it seems as if the blood-pressure of healthy men may be raised, unaltered, or decreased immediately after physical exertion.

It would appear that the diastolic readings tend more rapidly to rise (out of proportion to the systolic) in the later age-groups. This however, is to be expected after a survey of the resting pressures in men of corresponding ages.

A word must be said here with regard to the interpretation of the results of exercise shown in Appendices 2 - 5.

It is realised that the Sphygmomanometer is not a machine which is supremely accurate, and that the human blood-pressure varies from hour to hour according to the activities of the individual, physical or mental. And thus it might be argued that some of the results after exercise are so near the "resting" figures, that their meaning is ambiguous. (see, for example, No. 8 12 Appendix 2.) This is admitted; but nevertheless there has been a certain amount of activity immediately preceding the pulse-pressure reading, and it is not justifiable to say that the difference of a few millimetres of mercury does not constitute an individual reaction to exercise.

It is well known how quickly the increased pulse-rate returns to normal after exercise, (in health) in testing clinically for myocardial efficiency. This rapid fall of pulse rate must influence the pressure readings, and in some cases, perhaps, this fall had come about in part before the armlet could be adjusted and the pressure recorded. Still, it is believed that such cases are few in these lists; it was particularly observed that the pulse-rate was definitely increased in all the men examined after their exercise, and that the results justify the conclusions which have just been set forth.

EFFECTS OF A FULL MEAL ON HEALTHY PULSE PRESSURE.

The normal pulse-pressure has been seen to vary under the influence of exercise. It is a matter of common experience to anyone who is in the habit of using the Sphygnomanometer daily, that the readings taken of healthy individuals at rest also vary, at least a few millimetres, when taken at different times on the same day, under the same conditions.

In investigating the influence of a meal on pulse-pressure, readings were taken within 2 hours interval, one hour before, and 30 minutes after dinner. Unless the men examined were kept from work on purpose for the investigation, when frequent readings could have been made both before and after the meal, and averages struck, a simple procedure had to be adopted, and the former was chosen as being quite satisfactory.

Its possible fallacies are admitted. Thus, it may be argued that the small difference of, say, 2 millimetres between the pressure taken after a meal compared with that taken before is not sufficient to warrant the conclusion that the rise of pressure is due wholly to the meal, because already it has been noted that fairly wide variations of normal pulse-pressure occur without food having been taken.

Bearing all this in mind, and remembering that the readings were carefully recorded by the same method each time, it is proposed, nevertheless, to compare the two results in the form of a summary, which is set out below. This has been compiled from Appendix 8. where the full details will be found. The men, it should be explained, ranged in age from 20 to 40 years. The letters R. or T. by the man's name denote whether he has taken rum with his meal (R) or whether he is teetotal. (The "tot" of rum (neat) supplied to each man is 3ij)

SYSTOLIC PRESSURES.

	110-120	121-130	131-140	141-150	151-160
Before meal	28%	42%	30%	-	-
After meal	24%	34%	28%	12%	2%

DIASTOLIC PRESSURES.

	61-70.	71-80.	81-90.
Before meal	12%	54%	34%
After meal	24%	48%	28%

PULSE PRESSURES.

	40-45	46-50	51-55	56-60	61-65	66-70
Before meal	34%	48%	12%	4%	2%	-
After meal	18%	26%	18%	32%	2%	4%

Fifty men examined. Rise of pulse-pressure in 33 or 66%

It is justifiable to assume that pulse-pressure increases after a meal, even if minor rises, due to other and unimportant extraneous circumstances be admitted.

Nos. 8 and 16 in Appendix 8. show a definite and marked alteration, the remainder in varying degrees.

Whether the rum has any influence on this increase is doubtful, and in the absence of more extensive enquiries, no opinion can be expressed one way or the other: the tables showing the results are subjoined.

PULSE PRESSURES OF MEN TAKING RUM. (30 IN NUMBER)

	40-45	46-50	5I-55	56-60	6I-65	66-70
Before meal.	7.	I7.	6.	-	-	-
After meal.	5.	I8.	6.	9.	I.	I.

PULSE PRESSURES OF TEETOTALLERS. (20 in number)

	40-45	46-50	5I-55	56-60	6I-65	66-70
Before meal.	9.	7.	I.	2.	I.	-
After meal	5.	5.	2.	7.	-	I.

(These tables are not expressed in percentages.)

In regard to the systolic and diastolic pressures examined as separate factors, the tables given above demonstrate that the readings of the former tend to lie in the higher figures; those of the latter in the lower, after the meal. (see page 24).

This will explain how the increased pulse-pressures have been brought about.

EMOTION.

It was pointed out in the introductory remarks, that during the examination of normal subjects, there were some who exhibited undoubted signs of emotion. It will be remembered that the general appearance of the man, and his raised pulse-rate, gave a clue to his mental unrest.

Before estimating any pulse-pressure, it was usual to allow time for any temporary excitement on the part of the subject to die down. Those noted at the foot of each Appendix (from I - 6) were chosen as being typical examples of an emotional state.

The numbers collected were small, and the enquiry cannot be considered exhaustive; but it is instructive to note the considerable rise of pressure due to emotion in some cases, and to reflect on this influence in health and disease.

It will be noticed (Appendices I - 6) that the readings in the earlier age-groups 9 - I4. I5 - 20. 2I - 30. and 3I - 40 years show a high pulse-pressure, due to a rise in the systolic, and a more restrained diastolic pressure increase. After the age of forty, the diastolic figure rises sharply, and in the age-group 4I - 50 years the majority of pulse-pressures in emotional states are similar to the "resting" pulse-pressure for this age-group; in other words, the diastolic rise keeps pace, relatively, with the systolic pressure under emotion, and a normal pulse-pressure reading results.

In the next age-group, however, (5I - 60) in spite of a very high diastolic pressure, the systolic pressure will be noticed to have risen out of all proportion to it, and once more a high pulse-pressure results.

Judging from these figures, it would appear that emotion causes a marked rise of diastolic pressure after the age of 40, and as the diastolic pressure represents the load which the heart has to bear during diastole, the significance of this observation is clear.

Whether a healthy or a diseased heart is bearing this increased diastolic load, the result must be serious; on the one hand, favourable conditions are brought about for cardio-vascular hypertrophy, (and therefore worry and anxiety are included in the expressive term "wear and tear"); On the other hand, it is adding one more burden to the overwrought cardiac musculature.

In men below 40 years of age the diastolic pressure does not appear to be effected to such a marked degree, but the systolic pressure rises unduly high. The same fact emerges when dealing with the over-acting, or nervous heart, which appears to be healthy otherwise.

Considering the anxieties of life, many and varied, with which the majority of people must contend today, it cannot be said that large fluctuations of blood-pressure, such as have been described, are infrequent. And this may account, in part at least, for the great number of "high-pressure cases" encountered in medical practice at the present time.

The cases upon which observations have been made for the purpose of this section, are too few to permit of a full discussion on Emotion as a cause of raised pulse-pressure; but it is not without interest to reflect that the reaction of the Sympathetic Nervous System to anxiety or fear, (even that occasioned by a trivial clinical examination) might be of importance in this connection.

This primitive defensive mechanism, it is assumed, is as perfect and as sensitive now, as in the remote ages. The results of its activity, are slowly becoming better understood: its vasoconstrictor function is an accepted fact: the inter-relation between it and the activity of the adrenals and the thyroid gland has been demonstrated; the influence of adrenaline and thyroid secretion upon metabolism, has long been known. All these factors have an important bearing on the blood-pressure readings and should not be forgotten.

An organisation which was initiated to prepare the living body for defense or flight in the distant past, cannot logically be presumed to be evanescent, although it may be that the outward reaction to its activity has been modified.

Recently there has been described a simple method for continuous registration of blood-pressure.* The apparatus records systolic pressure only.

The authors state that continuous and lengthy observations can be taken without the subject being aware of the instrument.

Such an apparatus, by recording fluctuations in systolic pressure, should be valuable in demonstrating the effects of Emotion upon the cardio-vascular system.

EFFECT OF LYING IN BED 2 OR 3 WEEKS.

(AFTER HERNIOTOMY.)

It was not practicable to confine healthy men to bed for lengthy periods for the purpose of estimating their pulse-pressures. At the same time, it was considered important to discover if possible, the results of enforced inactivity. Luckily there were found in the Royal Naval Hospital, Haslar, certain Surgical cases who were undergoing a prolonged rest, although theirs could hardly be called a voluntary one.

They had been, in the large majority of cases, operated on for uncomplicated inguinal hernia; a few had suffered minor injuries to knee or foot, which necessitated avoidance of all exertion. These latter had not been operated on.

All were on full diet, and had been for at least I4 days, when they were examined. It was thought that this interval would preclude any ill-effects of the anaesthetic in those cases who had undergone operation.

Needless to say, no man was examined who had suffered any intercurrent illness or who had developed a complication. Their wounds, where such existed, were healed; no dressings were done; none of them suffered pain. In fact, the reason for their inactivity was purely a surgical one in the case of the herniotomies, and a sound scar was being aimed at before they were to be allowed up and about. No alcohol was being taken, but smoking was allowed.

Appendix 9. gives the details of these pressures. All observations were made with two or three readings being recorded.

Although the numbers collected are few, especially in the younger and older groups, it is interesting to record that the pulse-pressures, on the whole, tend to be high;

the diastolic pressures are much in accord with those already discussed in the corresponding age-groups of the active cases, and the systolic pressures all through are inclined to keep to high figures for age.

From these isolated cases of healthy men, strictly at rest in bed, the inference can be drawn that there is no lowering of the pulse-pressures.

It maybe that a healthy cardio-vascular system at rest, adequately nourished, keeps the blood-pressure figures the same, or nearly the same as those which would be found during short intervals of rest (such as were utilised in recording those in Appendices I - 6) during an active day. Or the enforced inactivity and generous feeding combined may produce pressor substances from the bowel, or metabolic poisons, or both, which unduly raise the systolic and diastolic pressures. It has been said that the former is slightly above the average for the age-groups.

RACIAL VARIATION.

Although the influence of race and of climate on pulse-pressure has not been investigated for inclusion in this Thesis, an article in the "Lancet" bears on this subject[X] The Author employed an Aneroid Sphygmomanometer (Down Bros.) and used the auscultatory method of determining his readings.

A thousand "apparently healthy male natives of all ages, ranging from 15 years to about 70 or 80" were examined, and their systolic, diastolic, and pulse-pressures recorded.

These natives lived on the shores of Lake Victoria Nyanza under most primitive conditions, which probably had not changed for centuries.

The altitudes at which the observations were made ranged from 3.500 ft. to 5.700 ft. The Author shows that, as regards pulse-pressure, this tends to rise gradually and uniformly from the age of 15 - 19 years up to 25 - 29 years. After this age it tends to decline until the age of 50 - 54 is reached. Thereafter, it again shows an upward grade.

On the average, 100 natives were examined in each age-group. These observations are regarded as of considerable importance. Probably variations in the mode of life, of race, and in climatic conditions strongly influence the blood-pressure readings.

SUMMARY OF CONCLUSIONS IN PART I OF THIS THESIS.

(I) Most boys examined (9 - I4 years) have a pulse-pressure of 40 - 45 m.m. of mercury.

(2) Pulse-pressure of youths from i5 - 20 years is 40 - 50 m.m.

(3) The age-group 2I - 30, shows pulse-pressure mostly between 46 m.m. and 50 m.m.

(4) The age-group 3I - 40 tends to be 40 - 50 m.m. and above.

(5) Men of 4I - 50 years have a pulse-pressure of 40 - 50 m.m. with a considerable number giving readings of 5I - 60 m.m. These latter are nearer 50 than 40 years of age.

(6) In the age-group 5I - 60, pulse-pressure rises to 56 - 65 m.m.

(7) The age of the subject plus I00 represents the maximum systolic pressure.

(8) Pulse-pressure is increased by physical exercise; also by emotional states up to the age of 40 years. For the I0 years following, the diastolic pressure increases proportionally with the systolic under Emotion, and a pulse-pressure of about the normal results. After 50 years, the systolic pressure rises relatively higher than the diastolic, and the pulse-pressure once more increases.

(9) In a not inconsiderable number of men, a full meal definitely increases pulse-pressure. The action of alcohol is uncertain in this respect.

(I0) Pulse-pressure is unaltered, or even tends to increase in healthy men who are confined to bed for two or three weeks.

PART 2.

PULSE-PRESSURE IN CERTAIN CARDIO-VASCULAR DISEASE.

Some examples of the common cardio-vascular diseases which have been observed during the Winter of 1929 - 30, will now be reviewed.

All the cases, with three or four exceptions, were examined at the Hospital for Diseases of the Heart, London. It was recognised that a more accurate diagnosis could be made at a Hospital where there were especial facilities for examining "heart cases": electro-cardiographic records, and X-ray examinations, (including ortho-diagrams) may be mentioned. After a thorough clinical examination of the patient, these latter investigations help materially in making an accurate diagnosis in difficult cases. And for the purpose of this review, an accurate diagnosis was essential.

In the first part of this Thesis, it has been noted that various influences may effect the blood-pressure records. Every effort has been made to exclude such influences in examining cases of heart disease.

The observations were made in a room apart from the post-Graduates who attend the practice of the Hospital; it was found that a crowd of strangers had a marked impression on the readings. Moreover, the patients were examined mid-way between meals, thus excluding any disturbing influence caused by digestion; they had all rested quietly in a warm waiting-hall before coming to the consulting room.

The great majority of the cases examined were males, because the observations on healthy pulse-pressure were confined to men. However, after a certain number of examinations of men had been carried out, there were added the blood-pressure readings of a few female patients, as these corresponded directly with the males. The sex of the patient is noted in all cases.

It has been said previously that the object of the present inquiry, is to determine the possible variation of pulse-pressure in some cardio-vascular diseases from the normal, and to define its diagnostic significance. The results in Part I of this Thesis will be used as a comparison.

A great number of the patients encountered at the Heart Hospital exhibited auricular-fibrillation. These have been excluded; The wholly irregular pulse in this condition renders a blood-pressure reading approximate only, and therefore unsatisfactory. The foregoing remark applies to cases of congestive failure, practically all of which were fibrillating. Those patients whose hearts fail with normal rhythm are very few, and it was thought that the two isolated cases observed during the past winter, were not sufficient to warrant a satisfactory conclusion being drawn from them. Therefore they have been omitted. There, remain however, forinvestigation certain common organic cardiac conditions which are met with in the Heart Hospital from day to day.

These latter cases have been divided into groups, as follows.-

I.- Aortic reflux, from all causes. This may be pure; but in some cases Mitral stenosis is found with it.

2.- Mitral Stenosis; no other value demonstrably affected.

3.- Myocardial degeneration.

4.- Hyperpiesis, used in the sense employed by the late Clifford Allbutt, i.e. independent of nephritis.

It is obvious that the two latter conditions could be associated; and, indeed it might be said that there may be a combination of any two or more of the cardio-vascular diseases in the above list. So from a pathological viewpoint, it is often questionable to separate them. Clinically, however, the cases investigated may be classified as shown; they presented signs which left no reasonable doubt as to their proper group.

PULSE-PRESSURE IN AORTIC REFLUX.

Before enquiring into the pulse-pressure changes in this condition, it is necessary to mention briefly the pathological changes which (it is assumed) have affected the valve.

Appendix IO. gives a list of patients presenting this valvular lesion, with a few notes on each case. It will be noticed that they have been grouped according to the aetiology.

First there are cases marked "Syphilitic aortitis and Aortic reflux". Here the vasa vasorum are diseased by Syphilis, (endarteritis obliteraus) and their lumen decreased; this in turn injures the middle and outer coats of the aorta by shutting off, or limiting, the blood supply to them. Necrosis is brought about, accompanied by weakening of the vessel wall, which may give rise to dilatation, localised or diffuse. The opening of the coronary arteries become partially occluded or blocked by the above mentioned process, and the coronaries themselves may (in the terminal parts) be involved. Thus arises the condition of syphilitic myocarditis. The cusps of the aortic valve are liable to be involved by the disease, which spreads down from the aorta, affecting firstly the aortic surfaces. Ultimately an aortic leak is brought about, when "the architecture of the valve is disturbed".

The rheumatic cases are due to an inflammation of the aortic valve during the course of a "rheumatic infection", either acute rheumatism, chorea, or tonsillitis, etc., There is usually, in addition, myocardial involvement. The ventricular surface of the aortic valve is that attacked first, and vegetations of various sizes make their appearance on it. Later, sclerosis of the valve occurs, allowing of stenosis, or regurgitation, or both. The mitral valve in these cases, unlike those due to syphilis, is frequently involved.

In older patients, when other symptoms and signs warranted it, the diagnosis of Atheroma was made. Here, it is presumed, the

degenerative process in the intima of the aorta extends to the aortic valve, and regurgitation results. The myocardium is frequently diseased in these cases because atheroma attacks the coronary arteries themselves, and blocks their openings from the aorta. Here, as in the syphilitic cases, dilatation of the aorta may occur, since a degeneration of its middle coat is common.

Having mentioned the types of lesion met with in the case of Aortic reflux described here, it is proposed now to enquire into the pulse-pressure alterations displayed in this condition.

Below is a summary of the findings in 40 cases, compiled from Appendix IO. pages 75 - 84.

Age.	5I-60.	6I-70.	7I-80.	8I-90.	9I-I00.	Over I00.	Total.
9-I4.	2.	I.	-	I.	-	I.	5.
I5-20.	-	2.	I.	-	-	I.	4.
2I-30.	-	3.	-	I.	-	4.	8.
3I-40.	-	2.	I.	-	I.	2.	6.
4I-50.	-	-	-	-	I.	3.	4.
5I-60.	-	I.	2.	I.	I.	4.	9.
6I-70.	-	I.	-	2.	I.	-	4.
	2.	I0.	4.	5.	4.	I5.	40.

From an examination of these figures, it will be observed that a remarkable increase in pulse-pressure has occurred in aortic regurgitation. An exception, however, must be made regarding two pulse-pressures of 60 - 70 m.m. which are shown opposite the age-groups 5I - 60 years and 6I - 70 years; and possibly, the two of 5I-60 m.m. shown in the age-group 9 - I4 years. For it has been demonstrated in

Part I of this Thesis that 50% of the men of 51 - 60 years had a pulse-pressure of 56 - 60 m.m. Regarding the boys, it is unlikely, but still possible, for the pulse-pressure to reach so high a figure in health, (owing, for example, to an unusually low diastolic reading). None of the healthy boys have a pulse-pressure above 50 m.m. (Appendix 7. Table IA); but in the next age-group (Youths of 15 - 20) one shows this. (Appendix 7. Table A).

Although, in a remarkable number of instances, patients with aortic disease do not present themselves for examination until the condition is well established, it is likely that "early cases" would show lower pulse-pressure, than "late cases" and for this reason: The high systolic, and relatively low diastolic pressures (compared with those in healthy subjects) are caused, firstly, by regurgitation of blood in diastole through an incompetent valve; secondly, anaemia of all the organs (including the heart itself) occurs when the reflux is of sufficient degree, and finally to compensate for this, the left ventricle endeavours to raise the general blood-pressure during systole.

Given a healthy myocardium, the heart will successfully fight the aortic valve reflux for years. In "early cases", this regurgitation must be much less; the diastolic pressure tends to be nearer normal, and it is not necessary for the left ventricle to increase the systolic pressure to a marked degree. The pulse-pressure will thus show little deviation from the "normal". The above remarks hold good, of course, in cases where the valve is affected but slightly, and comparatively little reflux of blood occurs through it in diastole. This probably explains the pulse-pressure of the man in the age-group 60 - 70 years (Appendix 10. Case 39.); the other patient, (50 - 60 years) ibid had a stenosis of the aortic valve in addition to a reflux, and this fact has had a distinct modifying influence on the blood-pressure readings. (Appendix 10. Case 5).

The two boys (see ante) with pulse-pressure only slightly above the normal, on further examination will be found to have a mitral stenosis as well as aortic reflux (Appendix 10. Cases 22 & 28).

and the former condition is doubtless asserting itself, the aortic valves being relatively only slightly affected.

Below is given the record of a case in which the pulse-pressure was actually lower than in health.-

A man, aged 29. was admitted to the Royal Naval Hospital, Haslar, in March 1930 with subacute rheumatism, affecting the knees and ankles. There was a previous history of rheumatic fever, and he presented well marked aortic disease with a loud blowing diastolic murmur conducted to the lower end of the sternum. The mitral valve, clinically, showed no lesion. The pulse was regular, not collapsing, and the rate was 80. There were no signs of failure. The temperature was raised, and the patient was perspiring. The other systems were normal. Blood-pressure readings showed a systolic pressure of 94 m.m. with a diastolic of 70 m.m. giving a pulse-pressure of 34 m.m. The man died; and at autopsy there was found evidence of old aortic disease, with acute endocarditis (shown by recent vegetations) affecting the same valve, and acute carditis. The mitral valve appeared healthy.

Here, in spite of a free reflux of blood through an extensively diseased valve, the impaired myocardium was unable to bear the burden; systolic pressure became low, instead of high, and a low pulse-pressure resulted.

To sum up, the great majority of cases of Aortic reflux examined had high pulse-pressure (36 out of the 40 patients under review). Certain influences may, however, modify this reading, and the importance of being on the look-out for them is emphasised. The high pulse-pressure figure is considered a valuable aid in the diagnosis of cases of Aortic reflux. The two cases following illustrate this:-

I.- R. H. 21. Male, was seen in the out-patient department at the National Hospital for Diseases of the Heart in January, 1930. He had a rheumatic history, with frequent tonsillitis since. He was somewhat pale, and on examination,

the apex beat was found to be forcible and in the V space, 4¼" from the mid-line. The left border of the heart appeared to be enlarged to the left. Auscultation revealed a diastolic murmur at the base, only heard with difficulty, and obtained by asking the patient to expire fully and hold his breath. The murmur was, however, plainly audible to the left of the sternum, at the level of the 4th rib. There was a systolic murmur at the apex, and the aortic diastolic bruit was heard here also. The pulse was regular, and the rate 78. No signs of failure were observed, and the other systems were normal.

Had the character of the murmur at the lower sternum not been noticed, it might have been said that this case was one of mitral disease. The blood-pressure readings were distinctive, as follows;

I72 - 66. I06 pulse-pressure.
I58 - 56. I02 " "

Had the pulse-pressure been ascertained before the clinical examination was carried out, the diagnosis would not have been in doubt.

F. M. Aged 34. Female.

This woman began to be breathless, easily tired, and to suffer from palpitation 2½ years ago. She had "Rheumatism" aged 5 and 25 years.

The patient was admitted to the Heart Hospital under Dr. Parsons-Smith; the heart was enlarged, the apex beat (forcible and heaving) in the VI space, and she showed auricular fibrillation. When examined during the end of February, it was found that the pulse had become regular with treatment. The heart was still enlarged, and there was a presystolic and diastolic murmur at the apex, with a presystolic thrill. There was a double murmur at the base, best heard down the left side of the sternum. The question of the origin of this basal murmur was a somewhat difficult one to decide. The blood-pressure readings were 118 systolic, with diastolic of 74. With a pulse-pressure of 44, the case, was not likely to be one of aortic reflux.

An Electrocardiographic tracing showed a right ventricular preponderance, and flattened T waves; An X-ray and ortho-diagram showed a large right ventricle and broad pulmonary artery; there was little abnormal about the appearance of the left ventricle. The diagnosis was mitral disease (stenosis) with probably sclerosis of the pulmonary valve, due to "back pressure" from the left heart, and giving rise to a pulmonary reflux. Had the pulse-pressure been ignored, it might have been concluded that in this case, there was aortic reflux with a fair amount of power in the myocardium.

Other illustrative cases could be cited, but these two exemplify the value of pulse-pressure estimation.

PULSE-PRESSURE IN MITRAL STENOSIS.

In mitral stenosis there is an obstruction to the flow of blood from the left auricle to the left ventricle. This obstruction is found of varying degree, and is progressive. Usually, the margins of the cusps are united, giving rise to a thickened, distorted valve which, according to the resultant form has been described as the "funnel-shaped mitral", or the "button-hole mitral".

The lesion is usually the outcome of acute rheumatic endocarditis, and most frequently occurs at an early age. It may, however, be found in older people in association with chronic kidney disease, or arterio-sclerosis. Here, it is thought, the same causes that give rise to arterial thickening produce a sclerosis of the mitral valve.

The lesion prevents an adequate supply of blood to the left ventricle during diastole, and this chamber at each systole passes less blood than normal into the systemic circulation. The heart wall itself is, therefore, poorly nourished. Moreover, the increasing stenosis causes hypertrophy of the left auricle, pulmonary congestion, broadening of the pulmonary artery, finally to enlargement of the right side of the heart. It is not surprising to find the systemic veins "full" in these cases.

Following this brief sketch of the general effects produced in mitral stenosis, it is proposed to enquire into the behaviour of the pulse-pressure in patients with this valve lesion.

The table below (page 42) has been compiled from Appendix II. (pages 85 - 89) where details of collected cases will be found.

As in aortic disease, an attempt was made to restrict the observations to men; but a few records of female patients have been added.

PULSE-PRESSURE.

Age.	3I-40.	4I-50.	5I-60.	6I-70.	7I-80.	Total Cases.
9-I4.	I.	I.	I.	-	-	3.
I5-20.	I.	I.	-	-	-	2.
2I-30.	5.	2.	-	-	-	7.
3I-40.	2.	I.	-	-	-	3.
4I-50.	I.	-	I.	-	I.	3.
	I0.	5.	2.	-	I.	I8.

In contrast to the cases of Aortic regurgitation, here there is a noticeable preponderance of low pulse-pressures (3I - 40 m.m.) Five patients give readings of 4I - 50 m.m. (compare with healthy subjects of the same age) Two cases have a pulse-pressure of 5I - 60 m.m. one, a boy (Appendix II. Case I. page 85.) had been in bed for three months. He had had acute carditis, which subsided. His pulse-pressure, taken on two separate occasions, was 52 m.m. which may be regarded as being within normal limits, as healthy boys of his age exhibited readings of 40 - 50 m.m.

The remaining case, (Appendix II. No. I7. page 88.) is that of a woman at the menopause; aged 49, in whom the pulse-pressure is moderate.

Finally there is one patient in the age-group 4I - 50 who shows a pulse-pressure of 7I - 80, (Appendix II. No. I8.Page 89.) This patient is believed to be a case of arterio-sclerosis with a partially sclerosed mitral valve, giving rise to clinical signs, but with little actual obstruction at the valve.

To summarise the above cases, it may be said that lesions of the mitral valve causing stenosis tend to exhibit a low pulse-pressure (below 40 m.m.); that a considerable proportion have a "normal" low reading (compared with the healthy subjects) and that a small proportion (I in I8) show a high pulse-pressure. Further, it will be observed (Appendix II. page 85.) that patients with this valve lesion who show marked clinical signs of the affection have the lowest pulse-pressure. Diastolic mitral bruits are regarded as indicative of fairly advances cases; these present the lowest pulse-pressure readings. It may also be remarked that the diastolic pressures tend to be high. The following may be given as an example of the value of pulse-pressure estimation in mitral disease. D.R. Aged 30. Male.

This patient was seen at the Heart Hospital in February I930. He had been perfectly well up to a year age, when he had a severe cold, which left him with a troublesome cough. Ever since then, he has complained of shortness of breath and almost continuous cough. No previous illnesses were admitted.

CARDIO-VASCULAR SYSTEM.

The apex beat was in the V space, 4 inches from the mid-line; a presystolic thrill was present, and well-marked presystolic and diastolic murmur at the mitral area. The pulmonary second sound was accentuated. There were some exocardial sounds, presumably due to old pericarditis ("milk spots") at the base; and at the level of the 4th. left intercostal space, near the sternum, a diastolic murmur, suggestive of an aortic reflux, was heard. (perhaps a faint diastolic murmur at the base would be obliterated by these exocardial sounds, and the valve of origin of this diastolic bruit was queried). The pulse was regular and full; rate 78. All other systems appeared normal. The blood-pressure reading was as follows:-
II8 systolic. 82 diastolic. Pulse-pressure 36 m.m.
Diagnosis: Mitral stenosis.

Here the pulse-pressure was the all important point in determining the origin of the DIASTOLIC bruit.

PULSE-PRESSURE IN HYPERPIESIS.

It has been explained on a previous page that the diagnosis of Hyperpiesis was made after excluding chronic renal disease.

In cases where it was considered necessary, blood-urea estimations were carried out, in addition to observing the daily quantity, chemical constituents, and concentration of "day" and "night" urine. The existence of a permanently raised blood-pressure was established by repeated examination of the patients at rest, as some were encountered who registered temporary super-normal blood-pressure, due, for example, to domestic worry and anxiety.

No case of organic valvular heart disease is included in this series.

Aetiological factors in the production of this condition include auto-intoxication from various sources, the teeth, tonsils, or digestive tract; over-eating and over-drinking; prolonged physical or mental strain, (the "wear and tear" of life), and the products of disturbed metabolic activity.

The pathological changes met with in Hyperpiesia comprise hypertrophy of the heart muscle (the left ventricle being espedially affected) and of the systemic arteries. These latter, on palpation, feel hard between the beats, the essential pathological lesion being a muscular hypertrophy of their inner and middle coats. In course of time, the artery tends to degenerate further and in this way organs (i.e. the kidney), which at first appeared healthy, may ultimately show signs of disease.

Appendix I2. (pages 90 - 93) gives, in some detail, a number of cases of Hyperpiesis collected for inclusion in this Thesis.

Below is a summary of these records.

PULSE-PRESSURE.

Age group.	M.M.				
	61-70.	71-80.	81-90.	91-100.	Over 100.
41-50.	2.	1.	-	-	1.
51-60.	1.	2.	3.	1.	3.
61-70.	1.	-	-	-	-

The above figures show that pulse-pressure in Hyperpiesis may range from 61 m.m. to over 100 m.m. Although in the majority of instances, the disease starts after middle life, this is not always the case, as younger patients may exhibit the syndrome. The following example illustrates this:-

H.R. Aged 18. Male.

This boy first came to the Heart Hospital 6 years ago. He was brought by his Father (who was also a patient); the latter suffered from Syphilitic aortitis and aortic reflux and is described in Appendix 10. (No.6.)

The boy complained of no symptoms, and his parent wished to find out "if he was all right", in view of his own disability.

On the first examination, the boy was found to have a high blood-pressure, and some degree of hypertrophy of the left heart. He has been under periodical examination since then, and although the blood-pressure remains high, the condition has improved under treatment, (a low protein diet with an ample supply of vegetable food, and intermittent courses of small doses of thyroid gland).

An exhaustive examination of the urinary system failed to demonstrate any lesion of

the kidneys. Hypernephroma was at one time seriously considered, but ultimately there was no evidence forthcoming to support this diagnosis.

Two recent examinations showed the heart to be hypertrophied; no valve lesion was detected, but the second sound at the aortic area was accentuated. The arteries were thickened. The blood-pressure reading was as follows.-

Systolic 170. Diastolic 94. Pulse-pressure 76.

The Wassermann reaction was positive; no other signs of congenital syphilis were observed. The patient complained of no symptoms, and was working.

This case is interesting in view of the generally accepted opinion that syphilis plays no part in the production of cardio-vascular hypertrophy, and also having regard to the age of the patient.

Cases of Hyperpiesis, with cardio-vascular hypertrophy, exhibit an abnormally high pulse-pressure. This may give rise to the suspicion that there exists a defect of the aortic valve, causing regurgitation, but auscultation of the heart, with or without electrocardiograms should exclude this condition. Where the diastolic pressure is relatively low, there may be produced a "collapsing" type of pulse, which will add extra weight to the diagnosis of aortic reflux. The two conditions may, of course, be combined.

The association of chronic renal disease and hyperpiesis, has previously been mentioned; and the fact that ultimately these patients may show evidence of fibrotic kidneys has been noted. This would remove them from the Hyperpiesis group of cases, which are regarded as separate and distinct clinical entities.

PULSE-PRESSURE IN MYOCARDIAL DEGENERATION.

Here, by myocardial degeneration is meant, that condition in which there is an increase of fibrous tissue in the wall of the heart, resulting in atrophy of the muscle fibres.

The cases shown in Appendix I3. (pages 94 - 97) all presented unmistakable signs of this disease. Some of the patients showed a concomitant vascular degeneration in the peripheral arteries, others presented scarcely any signs of this; but in each one, the myocardial disease was the most prominent feature, and the diagnosis was made accordingly.

Disease of the coronary vessels must be looked upon as the most important of the many causes of myocardial degeneration.

Coronary disease includes chronic arteritis, due to syphilis; the terminal portions of the coronary arteries themselves are affected, or an aortitis is set up, and the mouths of these vessels are thereby obstructed. Atheroma may occur in similar positions, and bring about the same result. Another important cause is high blood-pressure, and cardio-vascular hypertrophy (which has just been considered); and a more or less general fibrosis is apt to follow acute myocarditis. The disease when due to involvement of the coronary arteries, tends to be patchy or localised. There may or may not be an accompanying sclerosis of the valve cusps.

From whatever cause arising, myocardial degeneration is characterised pathologically by the gradual replacement of muscle fibres by fibrous tissue - the ventricles are affected far more than the auricles, which might almost be said to be unscathed.

With the exception of syphilitic cases, and those following acute myocarditis (in both of which the cause is understood), the aetiology of chronic interstitial myocarditis resolves itself into infective conditions, prolonged physical and mental strain, metabolic

poisons etc., factors accounting for hyperpiesis which has been discussed previously.

It is not surprising, therefore, to find myocardial and vascular hypertrophy occurring together in the same patient.

A SUMMARY OF THE PULSE-PRESSURE RECORDS DESCRIBED IN APPENDIX I3. IS GIVEN BELOW.

PULSE-PRESSURE.

Age group	M.M.						Over 100	Total
	41-50	51-60	61-70	71-80	81-90	91-100		
41-50	2.	I.	-	-	-	-	-	3.
51-60	2.	4.	I.	-	-	-	I.	8.
61-70	-	I.	2.	I.	-	-	-	4.
	4.	6.	3.	I.	-	-	I.	I5.

From a consideration of the above readings, it can be concluded that pulse-pressure may be well within the normal limit, or may be raised considerably above it, in myocardial degeneration.

Those cases who showed a pulse-pressure abnormally high for their age, were found to have very definite vascular degeneration of the peripheral arteries, super-added to myocardial disease.

They are, in fact, patients in whom high blood-pressure has played a part in the aetiology of the affection.

One case (Appendix I3. No. 8). who presented signs of cardio-vascular degeneration has a pulse-pressure of 53 m.m., only he will be observed to have a high diastolic pressure.

The remaining cases in Appendix I3. are shown as having either syphilitic involvement of the aorta, or atheroma affecting probably this and the coronary arteries.

CASES OF FORCIBLY ACTING HEARTS WITH NO APPARENT DISEASE.

Appendix I4.page 98.gives details of three typical cases of over-acting hearts, which on examination presented no signs of actual disease. It is considered justifiable to include them here, as such patients are frequently seen at the Heart Hospital, Out-Patients Department. Further, the increased pulse-pressure in each case is interesting.

It is necessary to exclude Aortic reflux, especially, in such patients, and to review the other causes of increased pulse-pressure readings, which have been discussed in the foregoing pages.

AORTIC STENOSIS.

During frequent visits to the National Hospital for Diseases of the Heart, a single case only of uncomplicated aortic stenosis was encountered, and for the purpose of this Thesis, the pulse-pressure of one isolated example is not sufficient, therefore it is not included. The lesion is of estreme rarity.

GENERAL CONCLUSION.

I. The pulse-pressure in health, determined in a considerable number of persons from 9 - 60 years, whose physical condition was good, and who were all free from ascertainable disease, is 40 - 65 m.m. Hg.

2. This pulse-pressure figure varies in health within somewhat wide limits, for reasons both trifling and transitory.

3. Pulse-pressure estimations must be made, in cardio-vascular disease, under the same conditions as those governing the observations made in Part I. of this Thesis.

4. The various disturbing factors in the circulatory equilibrium of a healthy person operate to vary the pulse-pressure estimation in sick persons, and must be obviated.

5. Nearly 100 patients suffering from common forms of cardio-vascular disease (with normal rhythm) have been examined, and the pulse-pressure findings discussed. High readings occur in Aortic reflux (with or without concomitant mitral disease); in cardio-vascular hypertrophy, and in cases where this latter condition is associated with considerable myocardial degeneration. Although, strictly speaking, they cannot be regarded as suffering from cardiac disease, patients with over-acting "nervous hearts" also have a high pulse-pressure.

In mitral stenosis, there is a marked tendency for the pulse-pressure to be low; normal or super-normal readings may however occur.

In myocardial degeneration, non-specific or otherwise, with no complicating valve lesion and no marked vascular degeneration, exhibit a pulse-pressure little removed from normal.

6. The pulse-pressure figure is of definite value in those cases of heart disease

which exhibit, on auscultation, an anomalous diastolic bruit towards the left lower border of the sternum; or where exocardial sounds are heard. A high reading suggests Aortic reflux; a low reading is against this diagnosis.

7. Pulse-pressure estimation is of less value in the diagnosis of mitral stenosis. Although the reading is commonly low in these cases, it is also frequently found to be within normal limits of the age-group concerned; these latter are often the "early cases". When the valve lesion has definitely declared itself, the pulse-pressure certainly becomes abnormally small, its diagnostic worth, however, in these later cases is, obviously, less.

8. The high pulse-pressure in Hyperpiesis, and in those patients with a combination of myocardial degeneration and super-normal blood-pressure, may wrongly suggest the diagnosis of Aortic reflux. Similarly, the "normal" reading obtained in many cases of myocardial degeneration, and in mitral stenosis, may suggest a healthy heart where physical signs are few, and clinical examination is hurried.

9. Pulse-pressure estimation cannot displace any accepted method of clinical examination in cardio-vascular disease, but may prove an extremely helpful adjunct to it.

oOo

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APPENDICES.

APPENDIX I.

PULSE PRESSURES IN HEALTHY MALES.

AGE-GROUP BETWEEN 9 AND I4 YEARS.

				Pulse pressure.
I.	I08	-	68.	40.
2.	II0	-	70.	40.
3.	I08	-	66.	42.
4.	II2	-	64.	48.
5.	II4	-	68.	46.
6.	II2	-	70.	42.
7.	I08	-	66.	42.
8.	I06	-	64.	42.
9.	II0	-	66.	44.
I0.	II4	-	68.	46.
II.	I04	-	64.	40.
I2.	II0	-	70.	40.
I3.	I08	-	66.	42.
I4.	I08	-	64.	44.
I5.	II2	-	68.	44.
I6.	I04	-	62.	42.
I7.	II4	-	72.	42.
I8.	I06	-	62.	44.
I9.	II4	-	70.	44.
20.	II2	-	72.	40.
2I.	II0	-	66.	44.
22.	II6	-	74.	42.
23.	II6	-	70.	46.
24.	II8	-	70.	48.
25.	I06	-	62.	44.
26.	II4	-	68.	46.
27.	II4	-	70.	44.
28.	I02	-	60.	42.
29.	II2	-	70.	42.
30.	I06	-	66.	40.
3I.	II6	-	72.	44.
32.	II4	-	68.	46.
33.	II0	-	70.	40.
34.	I08	-	64.	44.
35.	I06	-	64.	42.
36.	II4	-	74.	40.
37.	II2	-	68.	44.
38.	II0	-	66.	44.
39.	I04	-	62.	42.
40.	I06	-	66.	40.

cases showing reaction to Emotion:

1.	124	-	72.	52.
2.	130	-	76.	54.

APPENDIX 2.

PULSE PRESSURES IN HEALTHY MALES.

AGE-GROUP BETWEEN 15 AND 20 YEARS.

No.	Name.	Before exercise.	Pulse pressure.	After exercise.	Pulse pressure.
I.	Hawkins	118 - 74	44.	126 - 74	52.
2.	Hitchener	118 - 70	48.	140 - 76	64.
3.	Pipe	120 - 72	48.	124 - 76	48.
4.	Cook	114 - 70	44.	130 - 74	56.
5.	Law	120 - 70	50.	138 - 80	58.
6.	Ypung	124 - 80	44.	138 - 72	66.
7.	Royden	124 - 80	44.	148 - 90	58.
8.	Wilkinson	118 - 70	48.	130 - 78	52.
9.	Aspinall	118 - 74	44.	130 - 82	48.
10.	Watson	124 - 68	56.	140 - 78	62.
11.	Bantillier	124 - 74	50.	144 - 80	64.
12.	Ingham	122 - 74	48.	146 - 84	62.
13.	Gray	120 - 80	40.	136 - 76	60.
14.	Spencer	108 - 68	40.	124 - 70	54.
15.	Currie	112 - 66	46.	122 - 66	56.
16.	Reed	128 - 74	54.	144 - 80	64.
17.	Keevil	122 - 78	44.	140 - 88	52.
18.	Kemp	114 - 70	44.	125 - 78	47.
19.	Deverall	120 - 76	44.	142 - 82	60.
20.	Bishop	116 - 70	46.	146 - 80	66.
21.	Buckingham	118 - 78	40.	130 - 80	50.
22.	Ryan	124 - 80	44.	135 - 90	45.
23.	Healing	120 - 70	50.	146 - 86	60.
24.	Walton	120 - 80	40.	144 - 88	56.
25.	Connell	128 - 74	54.	150 - 86	64.
26.	Laws	118 - 76	42.	132 - 84	48.
27.	Keen	112 - 68	44.	120 - 70	50.
28.	Allan	116 - 76	40.	128 - 70	58.
29.	Daniels	116 - 74	42.	138 - 90	48.
30.	Potter	120 - 78	42.	130 - 70	60.
31.	Walter	114 - 60	54.	118 - 68	50.
32.	Williams	126 - 80	46.	134 - 74	60.
33.	Dore	118 - 70	48.	130 - 70	60.
34.	Marchant	120 - 74	46.	126 - 70	56.
35.	Dingwall	118 - 64	54.	150 - 90	60.
36.	Cawley	120 - 76	44.	130 - 80	50.
37.	Lodge	118 - 78	40.	130 - 84	46.
38.	Read	122 - 80	42.	142 - 72	70.
39.	Goodchild	116 - 74	42.	130 - 80	50.
40.	Piper	112 - 68	44.	132 - 74	58.

(Continued)

41. Prisgrove	II4 - 70	44.	I20 - 76	44.
42. Lewthwaite	II6 - 72	44.	I34 - 88	46.
43. Pitt	I24 - 80	44.	I34 - 80	54.
44. Doran	II8 - 68	50.	I30 - 80	50.
45. Arrow	I26 - 80	46.	I28 - 82	46.
46. Begg	I24 - 80	44.	I34 - 70	64.
47. Bleach	I22 - 80	42.	I42 - 88	54.
48. Doige	I20 - 72	48.	I42 - 86	56.
49. McCullen	I24 - 80	44.	I54 - 90	64.
50. Persoe	I22 - 78	44.	I44 - 84	60.

CASES IN THIS AGE GROUP SHOWING REACTION TO EMOTION.

Collins	I40 - 68	72.	I50 - 80	70.
Cooper	I40 - 74	66.	I40 - 72	68.
Goodhew	I38 - 72	66.	I72 - 80	92.
Manfield	I48 - 80	68.	I52 - 86	66.
Lett	I60 - 80	80.	I74 -I00	74.

APPENDIX 3.

PULSE PRESSURES IN HEALTHY MALES.

AGE-GROUP BETWEEN 21 AND 30 YEARS.

No.	Name.	Before exercise.	Pulse pressure.	After exercise.	Pulse pressure.
I.	Borrett	122 - 72	50.	174 - 80	94.
2.	Crew	128 - 78	50.	142 - 80	62.
3.	Gutteridge	122 - 79	43.	142 - 84	58.
4.	Dowsett	118 - 74	44.	136 - 76	60.
5.	Weaver	136 - 78	58.	160 - 78	82.
6.	Oxley	116 - 64	52.	142 - 70	72.
7.	Coates	130 - 80	50.	160 - 80	80.
8.	Smith	120 - 76	44.	142 - 84	58.
9.	Harding	128 - 74	54.	166 - 80	86.
10.	Snelling	138 - 88	50.	148 - 90	58.
11.	Merchant	120 - 76	44.	130 - 80	50.
12.	Ashcroft	110 - 68	42.	140 - 90	50.
13.	Chatfield	124 - 80	44.	150 - 90	60.
14.	Coffin	130 - 80	50.	140 - 90	50.
15.	Bishop	128 - 78	50.	152 - 86	66.
16.	Coker	124 - 80	45.	138 - 90	48.
17.	Whitmarsh	122 - 78	44.	138 - 90	48.
18.	Unwin	130 - 86	44.	160 - 88	72.
19.	Cornford	126 - 80	46.	140 - 86	54.
20.	Williams	120 - 78	42.	136 - 84	52.
21.	Rutledge	122 - 80	42.	138 - 90	48.
22.	Nash	128 - 86	44.	146 - 90	56.
23.	Barnes	124 - 80	44.	138 - 88	50.
24.	Johnson	122 - 72	50.	140 - 86	54.
25.	Gibson	126 - 82	44.	140 - 90	50.
26.	Lane	120 - 74	46.	138 - 86	52.
27.	Harding	130 - 86	44.	150 - 90	60.
28.	Hyland	120 - 72	48.	142 - 84	58.
29.	Breeze	122 - 80	42.	136 - 86	50.
30.	Tapsoll	118 - 78	40.	128 - 82	46.
31.	Whittle	128 - 78	50.	140 - 84	56.
32.	Rotter	128 - 80	48.	142 - 80	62.
33.	Frances	120 - 78	42.	136 - 84	52.
34.	Evans	120 - 76	44.	138 - 88	50.
35.	Abbott	118 - 70	48.	130 - 80	50.
36.	Woods	124 - 82	42.	144 - 82	62.
37.	Hastings	124 - 76	48.	134 - 80	54.
38.	Claridge	126 - 82	44.	140 - 84	66.
39.	Tocock	122 - 68	54.	136 - 76	60.
40.	Holdes	118 - 74	44.	128 - 80	48.

APPENDIX 3. (Contd.)

(Continued)

41. Wellbim	II8 - 76	42.	I30 - 82	48.
42. Gundry	I20 - 80	40.	I38 - 84	54.
43. Holmes	I26 - 82	44.	I44 - 86	58.
44. Elvin	II8 - 78	40.	I34 - 82	52.
45. Brawm	I30 - 80	50.	I44 - 86	58.
46. Smith	I24 - 74	50.	I36 - 80	56.
47. Kendall	I22 - 78	44.	I40 - 88	52.
48. Wood	I26 - 78	48.	I38 - 84	54.
49. Whittaker	I20 - 74	46.	I50 - 86	64.
50. Shaw	II8 - 78	40.	I42 - 88	54.

CASES IN THIS AGE GROUP SHOWING REACTION TO EMOTION.

Bowles	I48 - 78	70.	I64 - 86	78.
Prior	I50 - 80	70.	I66 - 86	80.
Watley	I40 - 86	54.	I50 - 88	62.
Hearne	I40 - 82	58.	I60 - 88	72.
Gregory	I46 - 88	58.	I60 - 92	68.

APPENDIX 4.

PULSE PRESSURES IN HEALTHY MALES.

AGE-GROUP BETWEEN 31 AND 40 YEARS.

No.	Name.	Before exercise.	Pulse pressure.	After exercise.	Pulse pressure.
1.	Coker	126 - 84	42.	134 - 88	46.
2.	Doughty	124 - 80	44.	138 - 90	48.
3.	Baldock	132 - 82	50.	150 - 80	70.
4.	Brimer	138 - 90	48.	142 - 100	42.
5.	Wort	130 - 80	50.	150 - 94	56.
6.	Walker	120 - 76	44.	154 - 72	82.
7.	Brewerton	134 - 86	48.	170 - 96	74.
8.	Parrick	115 - 60	55.	130 - 70	60.
9.	Cartridge	122 - 70	52	145 - 75.	70.
10.	Wells	140 - 85	55.	160 - 95	65.
11.	Willoughby	136 - 80	56.	150 - 90	60.
12.	Pannill	140 - 80	60.	168 - 86	82.
13.	Saunders	122 - 72	50.	148 - 82	66.
14.	Douglas	124 - 84	40.	136 - 86	50.
15.	Perry	124 - 78	46.	142 - 76	66.
16.	Gauntlett	124 - 74	50.	140 - 80	60.
17.	Harris	128 - 84	44.	138 - 88	50.
18.	Bushrod	122 - 78	44.	148 - 88	60.
19.	Clements	120 - 80	40.	142 - 90	52.
20.	Osborne	136 - 86	50.	148 - 78	70.
21.	Edom	115 - 70	40.	122 - 70	52.
22.	Mann	124 - 78	46.	124 - 72	52.
23.	Cooper	126 - 86	40.	146 - 90	56.
24.	Brice	118 - 70	48.	125 - 76	49.
25.	Crowhurst	118 - 72	46.	136 - 78	58.
26.	Haywood	125 - 84	41.	146 - 76	70.
27.	Peddle	130 - 84	46.	146 - 90	56.
28.	Rawlings	132 - 76	56.	140 - 80	60.
29.	Southwell	134 - 84	50.	150 - 88	62.
30.	Beir	110 - 70	40.	120 - 66	54.
31.	Draper	116 - 76	40.	122 - 80	42.
32.	Haycock	130 - 88	42.	138 - 92	46.
33.	Strange	124 - 72	52.	146 - 86	60.
34.	Moyse	124 - 84	40.	130 - 70	60.
35.	Markwick	124 - 74	50.	140 - 78	62.
36.	Wilmshurst	130 - 80	50.	144 - 88	56.
37.	Skinner	140 - 90	50.	160 - 100	60.
38.	Clift	118 - 70	48.	126 - 74	52.
39.	Ward	126 - 76	50.	124 - 84	40.
40.	Humphries	124 - 84	40.	140 - 84	56.

APPENDIX 4. (Contd.)

(Continued)

41. Mersell	I40 - 90	50.	I50 - I00	50.
42. Humphries	I32 - 84	48.	I50 - 86	64.
43. Hester	I30 - 80	50.	I64 - 88	76.
44. Colman	I30 - 80	50.	I54 - 88	66.
45. Cripps	I34 - 86	48.	I64 - I00	64.
46. Lewis	I28 - 84	44.	I58 - 92	66.
47. Read	I32 - 82	50.	I40 - 86	54.
48. Christmas	I26 - 82	44.	I5I - 89	62.
49. Morrell	I22 - 78	44.	I38 - 84	54.
50. Conway	I34 - 84	50.	I48 - 90	68.

CASES IN THIS AGE GROUP SHOWING REACTION TO EMOTION.

Dewey	I50 - 86	64.	I54 - 84	70.
Williamson	I65 - 90	75.	I80 - 94	86.
Moore	I48 - 86	62.	I64 - 96	68.
Ayles	I45 - 85	60.	I40 - 90	50.

APPENDIX 5.

PULSE PRESSURES IN HEALTHY MALES.

AGE-GROUP BETWEEN 41 AND 50 YEARS.

No.	Name.	Before exercise.	Pulse pressure.	After exercise.	Pulse pressure.
1.	Hope	135 - 82	53.	146 - 88	58.
2.	Stanfield	125 - 80	45.	150 - 90	60.
3.	Fletcher	136 - 84	52.	162 - 90	72.
4.	Webb	128 - 80	48.	138 - 80	58.
5.	Cowland	135 - 85	50.	147 - 85	62.
6.	Steel	138 - 86	52.	150 - 92	58.
7.	Witts	130 - 80	50.	144 - 86	58.
8.	Gulling	120 - 72	48.	142 - 86	56.
9.	Gulliver	150 - 90	60.	160 - 80	80.
10.	Smart	130 - 80	50.	138 - 88	50.
11.	Wood	118 - 76	42.	132 - 80	52.
12.	Male	132 - 82	50.	150 - 78	72.
13.	Wiltshire	142 - 86	56.	156 - 90	66.
14.	Moore	120 - 75	45.	132 - 80	52.
15.	Cummins	130 - 88	42.	146 - 90	56.
16.	Chadd	146 - 86	60.	166 - 86	80.
17.	Barfoot	126 - 74	52.	120 - 78	42.
18.	Burgess	132 - 82	50.	132 - 78	54.
19.	Menitt	150 - 88	62.	164 - 100	64.
20.	Milham	130 - 80	50.	130 - 84	46.
21.	Stanley	140 - 86	54.	152 - 92	60.
22.	Buckland	115 - 70	45.	125 - 76	49.
23.	Cowley	120 - 68	52.	120 - 70	50.
24.	Sellick	150 - 90	60.	160 - 86	74.
25.	Parkins	134 - 80	54.	142 - 80	62.
26.	Arnold	132 - 77	55.	152 - 86	66.
27.	Diaper	120 - 74	46.	130 - 80	50.
28.	Tinson	120 - 70	50.	140 - 90	50.
29.	Greenslade	140 - 92	48.	160 - 100	60.
30.	Lawford	138 - 90	48.	170 - 100	70.
31.	Goddard	146 - 92	54.	166 - 96	70.
32.	Hayward	140 - 90	50.	148 - 94	54.
33.	Gould	140 - 90	50.	150 - 96	54.
34.	Barker	140 - 86	54.	144 - 92	52.
35.	Howell	142 - 88	54.	148 - 90	50.
36.	Young	130 - 84	46.	145 - 96	49.
37.	Chisham	134 - 86	48.	162 - 92	70.
38.	Wakefield	150 - 88	62.	156 - 90	66.
39.	Bridges	138 - 90	48.	142 - 92	50.
40.	Linnell	136 - 90	46.	152 - 102	50.

APPENDIX 5. (Contd.)

(Continued)

41. Heritage	I38 - 88	50.	I42 - 92	50.
42. Tostevin	I40 - 90	50.	I46 -I00	46.
43. Hardy	I34 - 80	54.	I44 - 86	58.
44. West	I24 - 72	52.	I36 - 78	58.
45. McGuire	I42 - 87	55.	I54 - 90	64.
46. Bond	I46 - 88	58.	I58 - 94	64.
47. Twigg	I24 - 78	46.	I40 - 80	60.
48. Woodhouse	I34 - 80	54.	I48 - 88	60.
49. Stubbs	I22 - 76	46.	I38 - 82	56.
50. Grace	I36 - 82	54.	I48 - 88	60.

CASES IN THIS AGE GROUP SHOWING REACTION TO EMOTION.

Churcher	I46 - 96	50.	I54 -I00	54.
Tate	I60 - 94	66.	I68 -I00	68.
Cass	I60 -II0	50.	I70 -II0	60.
Allo	I50 -I00	50.	I70 -I06	64.
Dan. Smith	I54 - 96	58.	I80 -I00	80.
Good	I50 -I00	50.	I60 - 90	70.
Jarling	I54 - 96	58.	I60 - 98	62.

APPENDIX 6.

PULSE PRESSURES IN HEALTHY MALES.

AGE-GROUP BETWEEN 51 AND 60 YEARS.

No.	Name.		Pulse pressure.
I.	Fox	I50 - 90	60.
2.	Cole	I48 - 88	60.
3.	Mason	I52 - 90	62.
4.	Parker	I46 - 86	60.
5.	Bishop	I32 - 74	58.
6.	Harvey	I50 - 90	60.
7.	Manns	I46 - 90	56.
8.	Inglis	I52 - 90	62.
9.	Morgan	I46 - 88	58.
I0.	Avely	I38 - 84	54.
II.	Green	I52 - 88	64.
I2.	Cook	I50 - 88	62.
I3.	Chandler	I50 - 88	62.
I4.	Langridge	I46 - 84	62.
I5.	Ingram	I52 - 90	62.
I6.	Woodward	I50 - 90	60.
I7.	Scotson	I48 - 86	56.
I8.	Bell	I40 - 84	56.
I9.	Coombes	I42 - 86	56.
20.	Wright	I54 - 92	62.
2I.	Harris	I48 - 86	62.
22.	Peel	I54 - 88	66.
23.	Holmes	I48 - 88	60.
24.	Fleming	I50 - 90	60.
25.	Hawkins	I36 - 84	52.
26.	Arnold	I50 - 88	62.
27.	Goss	I55 - 90	65.
28.	Ladlow	I44 - 84	60.
29.	Harrison	I36 - 76	60.
30.	Collett	I42 - 80	62.
3I.	W.W.R.	I42 - 86	56.
32.	N.A.W.	I48 - 90	58.
33.	H.S.	I38 - 84	54.
34.	Mallett	I46 - 86	60.
35.	Book	I50 - 88	62.
36.	Shorter	I48 - 86	62.
37.	Fuge	I46 - 88	58.
38.	Harling	I48 - 86	62.
39.	Morgan	I36 - 80	56.
40.	Wilson	I42 - 80	62.

APPENDIX 6. (Contd.)

(Continued)

CASES IN THIS AGE GROUP SHOWING REACTION TO EMOTION.

Francis	I78 - II0	68.
Reed	I82 - II4	68.
George	I76 - II2	64.

APPENDIX 7.

This gives a summary of the longer detailed lists of systol, diastol and pulse-pressures.

TABLE I.A.

BOYS AGES 9 - I4 YEARS.

PULSE PRESSURES.

Reading.	Numbers.	Percentage.
40 - 45 mm.	33.	82 5%
46 - 50 mm.	7.	I7 5%
	40.	I00 0%

SYSTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
I00 - I09 mm.	I7.	42 5%
II0 - I20 mm.	23.	57 5%
	40.	I00 0%

DIASTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
60 - 70 mm.	35.	87 5%
7I - 80 mm.	5.	I2 5%
	40.	I00 0%

APPENDIX 7.

This gives a summary of the longer detailed lists of systol, diastol and pulse pressures.

TABLE A.

BOYS AND YOUTHS AGES I5 - 20 YEARS.

PULSE PRESSURES.

Reading.	Numbers.	Percentage.
40 - 45 mm.	30.	60%
46 - 50 mm.	I5.	30%
5I - 55 mm.	4.	8%
56 - 60 mm.	I.	2%
	50.	I00%

SYSTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
Below II0 (I08)	I.	2%
II0 - I20 mm.	32.	64%
I2I - I30 mm.	I7.	34%
	50.	I00%

DIASTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
60 mm.	I.	2%
6I - 70 mm.	I6.	32%
7I - 80 mm.	33.	66%
	50.	I00%

APPENDIX 7.

TABLE B.

MEN AGES 2I - 30 YEARS.

PULSE PRESSURES.

Reading.	Numbers.	Percentage.
40 - 45 mm.	28.	56%
46 - 50 mm.	I8.	36%
5I - 55 mm.	3.	6%
56 - 60 mm.	I.	2%
	50.	I00%

SYSTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
II0 - I20 mm.	I8.	36%
I2I - I30 mm.	30.	60%
I3I - I40 mm.	2.	4%
	50.	I00%

DIASTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
6I - 70 mm.	4.	8%
7I - 80 mm.	38.	76%
8I - 90 mm.	8.	I6%
	50.	I00%

APPENDIX 7.

TABLE C.

MEN AGES 3I - 40 YEARS.

PULSE PRESSURES.

Reading.	Numbers.	Percentage.
40 - 45 mm.	I8.	36%
46 - 50 mm.	25.	50%
5I - 55 mm.	4.	8%
56 - 60 mm.	3.	6%
	50.	I00%

SYSTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
II0 - I20 mm.	9.	I8%
I2I - I30 mm.	26.	52%
I3I - I40 mm.	I5.	30%
	50.	I00%

DIASTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
60 mm.	I.	2%
6I - 70 mm.	5.	I0%
7I - 80 mm.	2I.	42%
8I - 90 mm.	22.	44%
9I & over.	I.	2%
	50.	I00%

APPENDIX 7.

TABLE D.

MEN AGES 41 - 50 YEARS.

PULSE PRESSURES.

Reading.	Numbers.	Percentage.
40 - 45 mm.	5.	10%
46 - 50 mm.	22.	44%
51 - 55 mm.	16.	32%
56 - 60 mm.	5.	10%
62 mm.	2.	4%
	50.	100%

SYSTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
110 - 120 mm.	7.	14%
121 - 130 mm.	11.	22%
131 - 140 mm.	22.	44%
141 - 150 mm.	10.	20%
	50.	100%

DIASTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
61 - 70 mm.	3.	6%
71 - 80 mm.	16.	32%
81 - 90 mm.	29.	58%
Over 90.(92 mm.)	2.	4%
	50.	100%

APPENDIX 7.

TABLE E.

MEN AGES 5I - 60 YEARS.

PULSE PRESSURES.

Reading.	Numbers.	Percentage.
40 - 45 mm.	-	-
46 - 50 mm.	-	-
5I - 55 mm.	3.	7 5%
56 - 60 mm.	20.	50 0%
6I - 65 mm.	I6.	40 0%
66 - 70 mm.	I.	2 5%
	40.	I00%

SYSTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
I3I - I40 mm.	7.	I7 5%
I4I - I50 mm.	26.	65 0%
I5I - I60 mm.	7.	I7 5%
	40.	I00%

DIASTOLIC PRESSURES.

Reading.	Numbers.	Percentage.
7I - 80 mm.	5.	I2 5%
8I - 90 mm.	34.	85 0%
9I - 95 mm.	I.	2 5%
	40.	I00%

APPENDIX 8.

EFFECTS OF A FULL MEAL.

No.	T R	Name	Before meal.	Pulse pressure.	After meal.	Pulse pressure.
I.	R.	Gauntlett	I22 - 78	44.	I22 - 80	42.
2.	T.	Smart	I24 - 82	42.	I28 - 84	44.
3.	T.	Johnson	I20 - 78	42.	I34 - 78	56.
4.	R.	Smith	I20 - 70	50.	II8 - 76	42.
5.	T.	Hanson	I24 - 80	44.	I26 - 70	56.
6.	R.	Nash	I22 - 80	42.	I34 - 74	60.
7.	R.	Hanratty	I20 - 74	46.	I24 - 66	58.
8.	R.	Howlett	I34 - 88	46.	I58 - 88	70.
9.	R.	Wills	I20 - 74	46.	II4 - 74	40.
IO.	T.	Willmore	I34 - 72	62.	I40 - 80	60.
II.	T.	Gustar	I30 - 86	44.	I36 - 80	56.
I2.	R.	Leary	I30 - 76	54.	I36 - 84	52.
I3.	R.	Rawlins	I32 - 78	54.	II8 - 74	44.
I4.	T.	Cleverly	I32 - 76	56.	I28 - 76	52.
I5.	T.	Keamish	I30 - 80	50.	I20 - 70	50.
I6.	T.	Moyse	I24 - 76	48.	I28 - 68	60.
I7.	R.	Webb	II8 - 78	40.	I24 - 66	58½
I8.	R.	Panell	I38 - 84	54.	I26 - 76	50.
I9.	R.	Bowles	I34 - 84	50.	I36 - 84	52.
20.	T.	Urry	I30 - 72	58.	I50 - 78	72.
2I.	R.	Mogridge	II8 - 72	46.	I22 - 74	48.
22.	R.	Mayhew	I40 - 90	50.	I42 - 90	52.
23.	T.	Crockett	I32 - 80	52.	I20 - 78	42.
24.	R.	Saunders	I20 - 70	50.	I30 - 68	62.
25.	R.	West	I36 - 88	48.	I34 - 82	52.
26.	R.	Hay	I38 - 82	54.	I38 - 82	56.
27.	T.	Haycock	I34 - 88	46.	I20 - 80	40.
28.	T.	Barfoot	II6 - 72	44.	I20 - 70	50.
29.	T.	Wells	I34 - 90	44.	I46 - 86	60.
30.	T.	Beaumont	I24 - 74	50.	I30 - 70	60.
3I.	G.	Ambrose	II8 - 70	48.	II6 - 66	50.
32.	G	Day	I24 - 78	46.	I32 - 82	50.
33.	G.	Larvin	I30 - 84	46.	I26 - 80	46.
34.	G.	Hart	I30 - 80	50.	I42 - 90	52.
35.	G.	Cook	I34 - 80	54.	I50 - 90	60.
36.	G.	Penfold	I30 - 86	44.	I36 - 78	58.
37.	T.	Fuzzard	I40 - 90	50.	I38 - 90	48.
38.	T.	Eccott	I24 - 74	50.	I24 - 74	50.
39.	G.	Turness	I22 - 76	46.	I24 - 70	54.
40.	G.	Long	II8 - 70	48.	II0 - 70	40.

APPENDIX 8. (Contd.)

41.	T. Arliss	I28 - 88	40.	I34 - 80	54.
42.	T. Harris	II6 - 68	48.	II8 - 74	44.
43.	R. Smallbone	I24 - 80	44.	I36 - 78	58.
44.	T. Poulden	I30 - 86	44.	I20 - 70	50.
45.	R. Pragnell	I20 - 70	50.	I28 - 78	50.
46.	T. Cartridge	I28 - 88	40.	I22 - 78	44.
47.	R. Douglas	II8 - 72	46.	I20 - 72	48.
48.	R. Prior	I20 - 80	40.	I28 - 72	56.
49.	R. Baldock	I30 - 88	42.	I36 - 90	46.
50.	R. Town	I32 - 78	54.	I46 - 90	56.

APPENDIX 9.

PATIENTS IN R.N.HOSPITAL. HASLAR. WHO HAVE BEEN IN BED FROM THREE WEEKS TO A MONTH, OR MORE.

AGE - GROUP I5 - 20.

No.	Name.			Pulse pressure.
I.	Pope.	(Injury to Knee)	II6 - 72.	44.
2.	Howell.	(Rt. Ing. Hernia)	I24 - 80.	44.
3.	Lovegrove.	(Injury to knee)	II8 - 78.	40.
4.	Hyatt	(Injury foot)	I24 - 80.	40.
5.	Mason	(Fract. Patella)	I20 - 78.	42.
6.	Wells.	(Rt. Ing. Hernia)	II8 - 76.	42.

AGE - GROUP 2I - 30.

(Bed cases continued.)

I.	Chare	Rt. Ing. Hernia.	II6 - 70.	46.
2.	Stanley	"	I30 - 80.	50.
3.	Anderson	Hydrocele.	I34 - 86.	48.
4.	Humble	Rt. Ing. Hernia.	I22 - 78.	44.
5.	Goddard	Lt. Ing. Hernia.	I24 - 80.	44.
6.	Wood	"	I26 - 78.	48.
7.	Luxton	Rt. Ing. Hernia.	I26 - 80.	46.
8.	Groves	Rt. Hydrocele.	I24 - 82.	42.
9.	Tift	Rt. Ing. Hernia.	I28 - 78.	50.
I0.	Hopgood	Lt. Ing. Hernia.	I30 - 80.	50.
II.	Howard	Injury knee.	I32 - 74.	58.
I2.	Mansell	Rt. Ing. Hernia.	I20 - 78.	42.
I3.	Mercer	Lt. Ing. Hernia.	I22 - 80.	42.
I4.	Knight	Rt. Ing. Hernia.	II6 - 74.	42.
I5.	Fryer	Rt. Ing. Hernia.	I24 - 80.	44.
I6.	Croat	"	I30 - 82.	48.
I7.	Downer	Injury knee.	I22 - 74.	48.
I8.	Pantlin	Lt. Ing. Hernia.	I30 - 80.	50.
I9.	Coombs	Rt. Ing. Hernia.	I24 - 78.	46.

APPENDIX 9. (Contd.)

AGE - GROUP 31 - 40.

(Bed cases continued.)

I. Shield	Hernia.	I20 - 76.	44.
2. Field	"	I38 - 86.	52.
3. Hardy	"	I36 - 86.	50.
4. Hassett	"	I32 - 88.	44.
5. Tunnicliffe	"	I38 - 86.	52.
6. Crowther	"	I34 - 82.	52.
7. Baker	"	I36 - 84.	52.

AGE - GROUP 41 - 50.

(Bed cases continued.)

I. Varney	Hernia.	I26 - 80.	46.
2. Bradley	"	I44 - 88.	56.
3. Scott	"	I42 - 88.	54.

APPENDIX IO.

It must be assumed, that systems other than cardio-vascular, are normal unless otherwise stated, in this, and the remaining appendices.

LIST OF ABBREVIATIONS.

A.A.	Aortic area.
A_2	Aortic second sound.
A.B.	Apex beat.
B.P.	Blood-pressure.
C.N.S.	Central Nervous System.
C/o.	Complained of.
C.V.S.	Cardio-vascular system.
D/ic.	Diastolic.
Elect/m.	Electrocardiogram.
H.H.	National Hospital for Diseases of the Heart.
L.V.P.	Left Ventricular preponderance.
N.H., H.	Royal Naval Hospital, Haslar.
O.P's.	Outpatients Department.
P/h.	Previous health.
P_2	Pulmonary second sound.
P/r.	Pulse regular.
R.V.P.	Right ventricular preponderance.
S/ic.	Systolic.
Sy.	Syphilis.
V.D.	Venereal Disease.
W.R.	Wassermann reaction.

APPENDIX IO.

SYPHILITIC AORTITIS.

AORTIC REFLUX.

I. R.B. 29. Male. N.H., H.

Sent to Hospital as case of M.C.O. No symptoms. Sy. 1917. U.N.
Lungs clear.
C.V.S.- A.B. in 6th space, inside nipple line, heaving.
A.A. S/ic and D/ic murmurs, latter propagated to lower sternum. Both heard at apex. P/r.
X-ray chest.- "well-marked dilatation Ist part of aorta; no sacculation". W.R. Negative.
B.P. I30 - 50.
I40 - 54. 83.

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2. W.P. 60. Male. H.H.

C/o pain upper part chest; easily exhausted.
C.V.S. A.B. in VI space, 5¼" from mid-line.
P/r. 64. S/ic & D/ic murmur heard at A.A. latter, well-marked, blowing.
X-ray.- heart considerably enlarged to left & right, lies transversely.
Elect/m.- L.V.P. inverted T waves in leads I & II. W.R.- Positive.
B.P. I86 - 50.
I86 - 56. I33.

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3. C.F. 40. Male. H.H.

Complaint "pain in front of chest".
P/h.- Trench fever. Denies V.D.
C.V.S.- A.B. in V space. (nipple line)
A.A. blowing D/ic murmur, best heard left side sternum, on level with 4th space.
Aortic reflux.
W.R.- Positive. P/r. 78.
B.P. I70 - 90. 80.

APPENDIX IO. (Contd.)

SYPHILITIC AORTITIS. AORTIC REFLUX. (Contd.)

4.	F.G. 55. Male. H.H. C/o gripping pain in chest & palpitation. C.N.S.- 3rd nerve palsy. C.V.S.- A.B. forcible V space, inside nipple line. A.A. well-marked D/ic murmur. P/r - "collapsing" in type. X-ray.- some enlargement of heart to left. B.P. I72 - 50. I70 - 60.	II6.
5.	W.P. 54. Male. H.H. C/o praecordial pain on exertion exhaustion, dyspnoea. Sy. 38 years ago. C.V.S.- A.B. diffuse & difficult to palpate, in V space at nipple line. A large heart. P/r. small. Vessels thickened. S/ic thrill over the aortic base. S/ic & D/ic murmur at base, latter conducted to lower sternum, former into vessels of neck. In bed. B.P. I38 - 76. I42 - 74.	65.
6.	P.R. 57. Male. H.H. Attended H.H. years. C/o shortness ofbreath. History Sy. younger days. C.V.S.- Has fully developed aortic regurgitation, with D/ic murmur conducted to lower sternum. P/r. 79. X-ray.- no sign aneurysm of aorta. B.P. I56 - 54. I60 - 60.	IOI.
7.	A.E. 48. Male. H.H. C/o praecordial pain. C.V.S.- A.B. in nipple line, V space; heaving. X-ray.- Large heart & broad aorta. No aneurysm. Elect/m.- L.V.P. W.R.- Positive. D/ic murmur at A.A. conducted down sternum. S/ic murmur at apex. B.P. I60 - 44. I70 - 50.	II8.

SYPHILITIC AORTITIS. AORTIC REFLUX. (Cont.)

8. J.A. 46. Male. H.H.

Shortness of breath, palpitation
Discharged from Army with D.A.H. 1917.
Scarlet Fever in youth; Trench fever in war.
C.V.S.- Large heart. A.B. heaving, V space at nipple line. P/r. 80. Vessels somewhat thickened. D/ic murmur at A.A. conducted down sternum.
X-ray.- Left border of heart extends beyond normal limits. No aneurysm. W.R. Positive.
B.P. 176 - 60. 110.

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9. A.W.C. 41. N.H., H.

"Fainted" day before admission. Heart examined by Doctor, who sent him to Hospital. Sy. 1914.
C.V.S.- A.B. in 5th space, just outside nipple line. Loud S/ic & D/ic murmur, latter conducted down sternum. S/ic murmur at apex. P/r. 84. X-ray.- "a boot shaped heart; large aneurysm in first part of aorta".
W.R. B.P. 130 - 52.
156 - 60. 96.

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10. P.D. 45. Male. H.H.

C/o palpitation & praecordial pain on exertion. Sy. 1917.
C.V.S.- Heart ? enlarged. A.B. at nipple line. S/ic & D/ic murmur at A.A. latter propagated downwards. P/r 80. Vessels somewhat thickened.
X-ray.- no aneurysm, some enlargement of heart to the left. Elect/m.- L.V.P.
B.P. 166 - 58.
156 - 54. 105.

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11. W.P. 39. Male. H.H.

C/o "palpitation of the heart" & quickly tired. Frequent tonsillitis.
Denies V.D. C.V.S.- A.B. inside nipple line in the V space, forcible. P/r.
A.A. D/ic murmur conducted to lower sternum, S/ic murmur same area. X-ray.- No aneurysm.
B.P. 140 - 70. 70.

APPENDIX IO. (Contd.)

RHEUMATIC ENDOCARDITIS.

AORTIC REFLUX.

I2. A.K. I9. Male. H.H.

History of rheumatic infection. Very faint D/ic bruit at A.A. conducted to lower end of sternum, faintly heard at base. P/r. No symptoms. Doing well.
B.P. I50 - 86.
I52 - 82. 67.

I3. F.S. 22. Male. H.H.

C/o "palpitation, thought to be indigestion". P/h.- Tonsillitis, rheumatic pains, Influenza.
C.V.S.- A.B. (heaving) in V space, heart not enlarged. Pulse I06. S/ic & D/ic murmurs base & apex. B.P. I50 - 30.
I60 - 62.
I60 - 56. I07.

I4. C.W. 2I. Male. H.H.

C/o palpitation & weakness. Rheumatic infection in youth.
C.V.S.- A.B. is a punctate heave. X-ray.-Large heart. Aortic D/ic murmur conducted to lower end of sternum. Normal rhythm.
B.P. I72 - 64.
I68 - 60. I08.

I5. R.H. 2I. Male. H.H.

P/h.- "Rheumatism at I5 yrs. Frequent tonsillitis since.
C.V.S.- A.B. forcible & diffuse, 4¼" from mid-line. P/r. S/ic & D/ic murmur at base.
Elect/m.- L.V.P. B.P. I72 - 64.
I58 - 56. I05.

APPENDIX IO. (Contd)

RHEUMATIC ENDOCARDITIS.
AORTIC REFLUX. (Contd.)

I6. H.R. 3I. Male. H.H.

Was told by Dr. his heart "was not quite right". No complaint.
P/h.- "Influenza" badly 3 times.
C.V.S.- Heart enlarged, forcible A.B. 6th space 3¾" from mid-line, blowing D/ic bruit heard at base conducted down sternum.
W.R.- Negative. Elect/m.- L.V.P.
B.P. I54 - 46.
I70 - 46. I16.

I7. S.A. I4. Male. H.H.

C/o gripping pain in heart & palpitation. W.R.- Negative. Rheumatic history. A.B. heaving, V space. S/ic & D/ic murmurs at A.A. B.P. I45 - 60. 85.

I8. F.W. 3I. Male. H.H.

History of rheumatism.
W.R.- Negative. X-ray.- Heart enlarged.
Typical murmur. B.P. I44 - 80. 64.

I9. G.H. 55. Male. HH.

Rheumatic Fever when I2 years.
X-ray.- Heart enlarged to left & right.
A.B. heaving at nipple line. Aortic D/ic murmur at base, conducted down sternum, short S/ic murmur at apex.
B.P. I70 - 80.
I60 - 76. 87.

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20. C.W. 60. Male. H.H.

Attending years. C/o breathlessness, occasional papitation. Rheumatic history. Well-marked aortic D/ic murmur conducted to lower sternum. L.V.P. B.P. 200 - 66
2I0 - 70. I37.

APPENDIX IO. (Contd.)

RHEUMATIC ENDOCARDITIS.
AORTIC REFLUX. (Contd.)

21. J.C. 58. Male. H.H.

P/h.- Rheumatic Fever childhood & several subacute attacks since. Aortic D/ic murmur conducted to lower sternum. Vessels somewhat thickened. W.R.- Negative.
B.P. I70 - 94.
I64 - 90. 75.

AORTIC REFLUX.
MITRAL STENOSIS.

22. H.S. IO. Male. H.H.

Rheumatism 2 years ago. Scarlet fever since. X.ray.- Large heart, both ventricles + Post-cardial space filled in. P/r. Well-marked murmurs of aortic reflux & of Mitral stenosis. B.P. I32 - 76. 56.

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23. A.B. 34. Male. H.H.

No symptoms. Typical aortic D/ic murmur, & mitral presystolic murmur with thrill. W.R.- Negative. B.P. I70 - 66. I04.

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24. J.W. 36. Male. H.H.

Rheumatic Fever in youth. Frequent tonsillitis since. Now typical aortic regurgitant murmur, & presystolic murmur at apex. W.R.- Negative. X-ray.- Large left ventricle. B.P. I52 - 60.
I46 - 54. 92.

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25. S.M. 28. Male. H.H.

Scarlet Fever childhood; tonsillitis since. C/o dyspnoea & exhaustion. A.B. in V space 4½" from mid-line. Presystolic thrill; presystolic & D/ic murmur at apex, D/ic murmur at base, best heard at 3 rd left costal cartilage. B.P. I52 - 84. 68.

APPENDIX IO. (Contd.)

AORTIC REFLUX.
MITRAL STENOSIS. (Contd.)

26.	W.B. IO. Male. H.H. Rheumatic Fever when 6 yrs. Chorea since. No symptoms. Typical aortic murmur with presystolic murmur & thrill at apex. B.P. I30 - 60.	70.
27.	E.M. 20. Male. H.H. Growing pains in youth. Tonsillitis. Now dyspnoea climbing stairs. A.B. forcible in 5th space, 4" from mid-line. Aortic D/ic murmur at base; S/ic murmur & reduplicated first sound at apex. B.P. I44 - 80. I48 - 76.	68.
28.	H.R. I3. Male. H.H. Chorea 3 years ago. "which left his heart weak". Heart enlarged; D/ic murmur at base, heard best towards left border and conducted to lower sternum. Presystolic & D/ic murmur at apex with D/ic thrill. B.P. I08 - 52.	56.
29.	S.H. I7. Male. H.H. Definite rheumatic history in past. Now typical murmurs at base & apex. When examined, had been in bed for some weeks, on account of threatened failure, now up in ward and quite comfortable. B.P. I30 - 46. I26 - 50.	80.

APPENDIX IO. (Contd.)

AORTIC REFLUX.
MITRAL STENOSIS. (Contd.)

30. T.G.G. 27. Male. H.H.

History rheumatic fever. Came to H.H. Nov.I929. C/o breathlessness & giddiness. C.V.S.- Heart enlarged. A.B. VI space at the nipple line, heaving. Aortic D/ic murmur at base conducted down sternum, presystolic murmur at apex, with a snapping first sound. Pulse "collapsing". B.P. I76 - 64.
I68 - 60. III.

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31. H.R. II. Male. H.H.

Has had rheumatic fever twice. C.V.S.- Heart enlarged to right & left; forcible & diffuse A.B. VI space 4" from midline; typical D/ic murmur at A.A. presystolic S/ic and D/ic murmurs at apex.
Elect/m.- T waves flat in lead III
B.P. I44 - 36.
I48 - 42. I07.

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32. J.S. I9. Male. H.H.

Attending O-P's 3 years with large heart & typical murmurs of aortic reflux and mitral stenosis. Doing well.
B.P. I50 - 36.
I58 - 40. II6.

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33. R.S. 27. Male. H.H.

Definite rheumatic history. Now C/o palpitation & dyspnoea; neither symptom marked. C.V.S.- Heart enlarged, loud double aortic murmur at base, and thrill & presystolic murmurat the apex.
X-ray.- Left auricle enlarged. P/r not "water-hammer". B.P. I24 - 56. 68.

APPENDIX IO. (Contd.)

AORTIC REFLUX.
MITRAL STENOSIS. (Contd.)

34. T.B. 28. Male. H.H.

Rheumatic history. Has well-marked aortic reflux, with presystolic murmur at the apex, where the first sound is accentuated & ringing.
B.P. I30 - 60. 70.

35. M.H. 59. Male. H.H.

Attending H.H. many years with aortic disease & mitral stenosis (result of rheumatic endocarditis in youth) "doing very well"; very few symptoms.
B.P. 200 - I20. 80.

VASCULAR DEGENERATION.

AORTIC REFLUX.

ARTERIO-SCLEROSIS.
(probably) SCLEROSED VALVE.
AORTIC REFLUX.

36. I.G. 63. Male. H.H.

Pain across sternum & down both arms on exertion, ceases with rest.
Rheumatic Fever at 2I yrs. No other illnesses.
W.R.- Negative. P/r. 70. Vessels thickened.
Retinal vessels tortuous & "silver wire".
X-ray.- Large heart. D/ic & S/ic murmurs at A.A. B.P. I90 - I00. 90.

APPENDIX IO. (Contd.)

ATHEROMA OF AORTA.
AORTIC REFLUX.

37. S.P. 65. Male. H.H.

"Anginal" symptoms, pain down left arm. No illnesses except Influenza. W.R.- Negative. P/r. 72. Vessels thickened. C.V.S. A.B. 6th space at nipple line. Left border enlarged to left. S/ic & D/ic murmurs at aortic base: S/ic murmur at the mitral. B.P. I60 - 60.
I54 - 60. 97.

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38. W.J. 70. Male. H.H.

C/o dyspnoea on exertion. Urine.- Trace albumen. S.G. I008. C.V.S.- A.B. 3½" from mid-line in 6th space. P/r save for very occasional extra systole. A.A.- S/ic & D/ic murmurs. Elect/m.- T waves flattened.
B.P. I45 - 60.
I40 - 60. 83.

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39. J.C. 67. Male. H.H.

C/o pain front chest; giddiness & swimming feelings. C.V.S.- Pulse 84. Not collapsing. Vessels thickened. A.B. heaving, 4½" from mid-line in V space. All sounds rather toneless. D/ic murmur at A.A. S/ic murmur at mitral. Urine.- Trace albumen. Elect/m.- Inverted T waves in lead II & III L.V.P. B.P. I62 - I00. 62.

SCLEROSED AORTIC VALVE.
AORTIC REFLUX.

40. A.E. 58. Male. H.H.

Anginal symptoms. No. V.D. W.R.- Negative. C.V.S.-Heart enlarged to left, 4¾" from mid-line in VI space. Vessels thickened; retinal vessels tortuous. B.P. I70 - 70. I60 - 76. 92.

APPENDIX II.

MITRAL STENOSIS. (PURE)

I. N.N. IO. Male. H.H.

Admitted October I929 with rheumatic re-infection (subacute) & carditis. This latter completely subsided, leaving signs of mitral stenosis (presystolic & D/ic bruits. B.P.- Jan. I930. Io6 - 54.
I08 - 56. 52.

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2. A.S. I4. Male. H.H.

P/h.- Chorea & rheumatic fever a year ago. Came to H.H. O.P's 3.2.30. said to have Mitral stenosis. No symptoms. Heart appeared enlarged both clinically & by X-ray. Short presystolic, and S/ic murmur at apex. P_2 +. B.P. II6 - 84. 32.

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3. F.S. 35. Male. H.H.

Scarlet Fever in youth. Now has presystolic, D/ic & S/ic murmurs at apex.
B.P. I23 - 92.
I20 - 87. 32.

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4. A.G. 20. Female. H.H.

Definite rheumatic history. C/o praecordial pain & palpitation. Heart enlarged to left; A.B. 4½" from mid-line. Presystolic thrill & murmur at mitral area. X-ray.- Middle third post-cardiac space occluded by left ventricle.
B.P. II8 - 76. 42.

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5. RHEUMATIC ENDOCARDITIS.
MITRAL STENOSIS.

B.L. 45. Male. H.H.

P/h.- Rheumatism 3 years ago, alleged "strained heart" 5 years ago.

(Contd page 86.)

APPENDIX II. (Contd.)

RHEUMATIC ENDOCARDITIS. (Contd.)
MITRAL STENOSIS.

5. (Contd.) Heart not much enlarged clinically. P/r. 74. Firm. Vessels not thickened on palpation. Well-marked presystolic & D/ic murmurs at apex; 2nd pulmonary accentuated & reduplicated.
B.P. I20 - 80. 40.

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6. E.M. I5. Male. H.H.

Scarlet Fever yr. ago. Came to H.H. for "bad palpitation", & pains in limbs. C.V.S.- Heart somewhat enlarged. A.B. at nipple line. No thrills. Left border "out" clinically. P/r. 82. "firm" in character. S/ic & short presystolic murmur at mitral area, with snapping first sound. P_2 accentuated & reduplicated. B.P. II8 - 84. 34.

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7. R.F. 3I. Male. H.H.

Rheumatism when I2 yrs. several relapses. (not acute rheumatism) Presystolic, & D/ic murmurs at apex. Heart not enlarged.
B.P. I29 - 72. 37.

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8. M.R. I3. Male. H.H.

Elect/m.- R.V.P. P waves large & broad. Apical thrill. Heart + to left & right. A.B. 3½" from mid-line. Presystolic murmur at apex. P/h.- Rheumatic fever I929. C/o weakness, dyspnpea ? No failure. P_2 accentuated.
B.P. II2 - 68.
II2 - 70. 45.

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9. R.R. 24. Female. H.H.

Rheumatic fever in youth. Now dyspnoea, "pains round heart". Presystolic murmur mitral area. P_2 + Exocardial sounds "crackles" at base, and a "to & fro" sound at bottom of sternum, giving rise to suspicion

APPENDIX II. (Contd.)

RHEUMATIC ENDOCARDITIS. (Contd.)
MITRAL STENOSIS.

9. (Contd.)	of aortic reflux murmur. (probably pericardial). B.P. I39 - 90. I34 - 88.	47.
I0.	M.W. 30. Male. H.H. History Rheumatic fever when 8 yrs. C/o"pain in the heart" Dyspnoea. Heart enlarged: A.B. 4" from mid-line. Presystolic thrill & loud murmur at apex, also S/ic mitral murmur. P_2 + P/r. 80. Vessels not thickened. B.P. I20 - 86. I26 - 90.	35.
II.	E.R. 24. Female. H.H. History Chorea & tonsillitis. Thrill at mitral area. Short presystolic & loud blowing S/ic murmur at mitral area, more distant diastolic. P_2 accentuated. B.P. I20 - 90. II4 - 80.	32.
I2.	B.R. 29. Male. H.H. Heart enlarged to right & left. P/r. 76. Firm. D/ic murmur at mitral. P_2 + & reduplicated. (has parox. auricular fibrillation) B.P. I30 - 98. I28 - 94.	33.
I3.	E.L. 25. Male. H.H. D/ic murmur at apex. Snapping first sound. Thrill. Pulmonary second sound accentuated. Heart not enlarged. P/r. B.P. I20 - 80. I24 - 86.	39.

RHEUMATIC ENDOCARDITIS. (Contd.)
MITRAL STENOSIS.

I4. E.B. 22. Male. H.H.

Rheumatic Fever when 6 yrs old. Tonsillitis since. Heart not enlarged. Snapping first sound & short presystolic murmur. P_2 + Elect/m.- prominent P. waves.
B.P. I24 - 80.
I28 - 82. 45.

I5. F.C.B. 3I. Male. H.H.

"Growing pains" & tonsillitis in past. A.B. just inside nipple line. Left border not enlarged. Presystolic murmur & typical first sound at apex. P_2 + Post-Cardiac space clear. P/r & full.
B.P. I22 - 80.
I26 - 82. 43.

(EARLY) MITRAL STENOSIS.

I6. H.F. 25. Male.N.H.H.

P/h.- "Growing pains" as a child, no other illness. Pain over praecordium on exertion only, dyspnoea. P/r varied in frequency between 44 - 48. No failure. Vessels not thickened. Heart not enlarged. A.B. in V space, inside nipple line: no thrill. S/ic murmur at apex, & short presystolic, ending in snapping first sound. P_2 +
B.P. I26 - 88.
I30 - 90. 39.

MENOPAUSE.
MITRAL STENOSIS.

I7. M.M. 49 Female. H.H.

A.B. 4½" from mid-line. Thrill: presystolic & D/ic mitral murmurs. P_2 +
B.P. I70 - II0.
I60 - II0. 55.

APPENDIX II. (Contd.)

RHEUMATIC ENDOCARDITIS. (Contd.)
MITRAL STENOSIS.
ARTERIO-SCLEROSIS.

I8. A.B. 44. Male. H.H.

High S/ic B.P. No symptoms. Prominent P waves. X-ray.- Clear posterior cardiac space. Presystolic murmur at apex. The high B.P. is unusual in young people, in older ones, both the valve disease and arterio-sclerosis may be due to same cause, resulting in sclerotic changes in both arteries and valves.

B.P. I60 - 87. 73.

APPENDIX I2.

HYPERPIESIS - CARDIO-VASCULAR HYPERTROPHY.

I.	S.G. 59. Male. H.H. C/o giddiness, exhaustion, palpitation & insomnia, unable to work. "silver wire" arteries. W.R.- Negative. C.V.S.- A.B. V space. No bruits heard, but A_2 + B.P. I68 - 85. I58 - 74.	83.
2.	S.M. 68. Male. H.H. C/o pain left side chest, breathless & giddy. Vessels not very thickened to palpation but retinal vessels look pathological. Heart enlarged to the left, S/ic murmur over mitral area. P/r. B.P. 200 - I30.	70.
3.	T.A. 60 Male. H.H. Chief complaint; giddiness dyspnoea. Heart enlarged clinically & by X-ray; 2nd sound in A.A. ringing; no bruits, Vessels thickened. B.P. 250 - I30. 228 - I24.	II2.
4.	P.A.W. 55. Male. H.H. Similar symptoms to No. 3 above but C/o also of palpitation, (occasional extra systoles on examination) Heart enlarged. Vessels thickened. B.P. 280 - I40. 270 - I30.	I35.
5.	S.A. 49. Male. H.H. C/o occasional buzzing in head, dyspnoea. Vessels thickened. Heart enlarged. Elect/m.- L.V.P. B.P. 200 - I40. 2I0 - I40.	65.

APPENDIX I2. (Contd.)

HYPERPIESIS. (Contd.)

6.	C.W. 52. Male. H.H. C/o dyspnoea, giddiness. X-ray.- Large heart. Vessels thickened & tortuous. B.P. I90 - I20. I82 - II6.	73.
7.	W.P. 56. Male. H.H. Slight praecordial pain, & giddiness occasionally; indigestion. Retinal arteries appear thickened. B.P. I82 - II0.	72.
8.	M.C. 60. Male. H.H. Some impairment of memory, & praecordial pain, dyspnoea. All vessels very thickened. Retinal arteries "silver-wire". B.P. I74 - I00. I62 - 96.	70.
HIGH B.P. ARTERIO-SCLEROSIS.		
9.	J.C. 45. Male. H.H. C/o pain over heart, radiating down left arm, worse on exercise. Urine.- Trace albumen. C.V.S.- A.B. heaving in 5th space. W.R.- Positive. B.P. 200 - I40. I94 - I24. 200 - I20.	70.
I0.	E.R. 55. Male. H.H. C/o palpitation, easily exhausted. Large heart & thickened vessels. B.P. 2I0 - II0.	I00.

APPENDIX I2. (Contd.)

HIGH B.P.
ARTERIO-SCLEROSIS.

II. G.B. 47. Male. H.H.

P/h.- No illnesses up to 2 wks. ago. Suddenly spat blood, teaspoonful. Sent to T.B. dispensary by Dr. - Negative findings. Sent to H.H. O.P's I7.2.30. P/r. Vessels thickened. Arcus senilis well-marked. Heart. A.B. 4" from mid-line. Mitral area S/ic murmur. Second sound relatively increased in all areas. Elect/m.- N. X-ray.- N.
B.P. I84 - I08. 76.

HIGH B.P.
CARDIO-VASCULAR DEGENERATION.

I2. E.L. 56. Male. H.H.

X-ray.- Large heart enlarged to left. S/ic murmur at apex. Aortic second sound markedly accentuated. Vessels thickened.
B.P. I80 - II0.
220 - I20. 85.

I3. G.E. 50. Male. Private Case.

Heart not much enlarged. A.B. at nipple line. S/ic murmur at apex. 2nd. sound reduplicated. Aortic second markedly accentuated. Vessels thickened.
B.P. 200 - I20.
I84 - I2o.
I74 - II0. I04.

High B.P.
No obvious VASCULAR DEGENERATION.

I4. A.M. 54. Male. H.H.

C/o throbbing in neck & breathlessness for I yr. Heart enlarged clinically, 4½" from mid-line. S/ic mitral murmur. Heart markedly enlarged to left on X-ray.
B.P. 240 - I20. I20.

APPENDIX I2. (Contd.)

HYPERPIESIS. (Contd.)
SYPHILITIC AORTITIS.

I5. F.P. 57. Male. H.H.

Attended O.p's two years. C/o of substernal pain. Second sound at A.A.+
X-ray.- Diffuse dilatation whole of Aortic arch. Heart enlarged to left. No valvular disease.
B.P. 204 - I20. 84.

APPENDIX I3.

MYOCARDIAL DEGENERATION.

I. R.M. 60. Male. H.H.

C/o giddiness, occasional fainting fits, headache, dyspnoea. Sounds toneless. P/r. W.R.- Negative. Elect/m.- L.V.P. Flat T waves.
B.P. I50 - 96.
I52 - 94. 56.

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2. A.R. 59. Female. H.H.

Rheumatic fever at 7 & 28 yrs. Now "fluttering at the heart, giddiness, short of breath". P/r. Heart not enlarged. Ist sound at mitral toneless: soft S/ic bruit. 2nd sound at A.A. relatively accentuated. Elect/m.- L.V.P. T/I & T/3 flat. X-ray.- Aorta opaque. Prominent arch.
B.P. I70 - I04.
I60 - I00. 63.

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3. A.B. 67. Male. H.H.

C/o anginal pain, giddiness. Heart somewhat enlarged to left. All sounds toneless.
B.P. I58 - 90. 68.

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4. S.S. 54. Male. H.H.

C/o retro-sternal "stretching pain" 3 or 4 years. Unable to do much physical exertion. Heart not enlarged clinically. All sounds distant & toneless. Vessels not markedly thickened. Elect/m.- T waves flat in leads II & III.
B.P. I50 - 94. 56.

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5. M.B. 54. Female. H.H.

"Breathless & tired". Praecordial pain, radiating down left arm. Heart not enlarged. Regular rhythm. Vessels

APPENDIX I3. (Contd.)

MYOCARDIAL DEGENERATION. (Contd.)

5. (Contd.)	not unduly palpable. All sounds toneless & distant; soft S/ic murmur at apex. Elect/m.- T waves flat in all leads. B.P. I30 - 90.	50.
6.	T.W. 40. Male. H.H. C/o retro-sternal pain & dyspnoea. No focal sepsis found. W.R.- Negative. Elect/m.- Flat T & P waves in all leads. B.P. I30 - 80. I36 - 78.	49.
7.	E.B. 60. Male. H.H. All other systems normal. Only complaint "throbbing in the head". B.P. 244 - I30. 238 - I30.	III.
8.	H.G. 65. Male. H.H. Anginal symptoms, related to epigastrium. A.B. 4¼" from mid-line. Sounds toneless. Elect/m.- T waves flat in all leads. X-ray.- Aortic arch prominent. B.P. I56 - I00. I50 - I00.	53.
9.	C.A. 5I. Male. H.H. Heart not enlarged; sounds distant & toneless. W.R.- Negative. B.P. I50 - 90.	60.

APPENDIX I3. (Contd.)

MYOCARDIAL DEGENERATION. (Contd.)
SYPHILITIC AORTITIS.

I0.	W.L. 59. Male. H.H. No heart murmurs. B.P. I44 - I00.	44.
II.	A.J.N. 46. Male. H.H. Heart not enlarged. No aneurysm, seen in X-ray, but aorta broad. W.R.- Positive. B.P. I32 - 82.	50.
I2.	W.M.B. 47. Male. H.H. C/O pain "high up front of chest" No aneurysm seen. W.R.- Negative; History of Syphilis. B.P. I40 - 90. I52 - 96.	53.

ATHEROMA.

I3.	W.W. 66. Male. H.H. Chief complaint, retro-sternal pain. A.B. in V space, at nipple line, heart apparently enlarged. Sounds very distant at base, & toneless at apex. W.R.- Negative. Elect/m.- flat T waves. B.P. I40 - 80. I46 - 84.	6I.
I4.	C.A.H. 60. Male. H.H. C/o substernal pain & "indigestion" for 3 years. X-ray.- & Elect/m.- bear out the diagnosis. W.R.- Negative. B.P. I50 - 94. I52 - 90.	59.

APPENDIX I3. (Contd.)

MYOCARDIAL VASCULAR DEGENERATION.
HYPERPIESIS.

I5. G.W. 64. Male. H.H.

Came to O.P's 4th Nov. I929.
C/o giddiness, loss of power in legs, headaches, and some intermittent clandication. All vessels thickened, retinal vessels "silver wire". A.B. VI space, 3¾" from mid-line. Soft S/ic murmur at apex. No failure. Elect/m.- Flat T waves; L.V.P.
B.P. 208 - I28. 80.

APPENDIX I4.

CASES OF FORCIBLY-ACTING HEARTS WITH NO APPARENT DISEASE.

I.	B.A. I9. Male. H.H. P/r. II8. Heart not enlarged clinically or by X-rays. Functional (pulmonary) S/ic murmur. B.P. I56 - 90.	66.
2.	K.T. I4. Male. H.H. Sent up by Dr. to see whether he could play games. Only child, always delicate, but no illness except influenza twice, tonsillectomy year ago. Is obviously overgrown & pale. P/r. I20. Heart not enlarged. S/ic murmur at apex and base. Elect/m.- simple tachycardia. B.P. I36 - 80.	56.
3.	J.M. I7. Male. H.H. "Palpitation" on going upstairs, for some weeks. No disease found in heart. Pulse I04. Elect/m.- simple tachycardia. B.P. I40 - 80.	60.

SURGEON COMMANDER. C.V.O. O.B.E. M.B. F.R.C.S.E.

4TH MARCH 1930. ROYAL NAVY.

24. VII. 30.