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## President of the Ulster Medical Society 1942–43

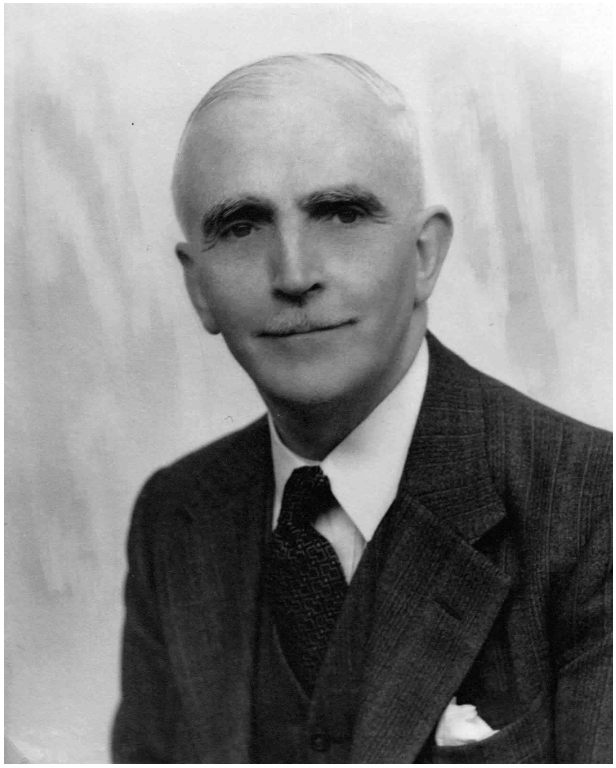
**Presidential Opening Address**
Ulster Medical Society

SOME ASPECTS OF MYOCARDIAL DISEASE

Ladies and Gentlemen, The subject about which I should like to talk to you this afternoon is one to which there has been devoted a great deal of patient and diligent research, both clinical and pathological, not only in these islands, but perhaps to an even greater extent on the Continent of America.

It appears to have been tacitly agreed that the word myocarditis should be restricted to purely inflammatory conditions and their sequelae, and that it should not include the degenerations, and the changes in heart-muscle which are thought to be the result of disease of the coronary vessels themselves. From a strictly etymological point of view this restricted application is open to criticism, because the suffix "itis" is (I am informed by my friend the Reverend Principal Davey, for I, like the Vicar of Wakefield, have very little Latin and less Greek) a Greek ending of feminine nouns and adjectives, and means belonging to or concerned with, as in ή γυνη ή Σαμαρείτις, the woman belonging to Samaria. In Greek medicine it was used originally as an adjective with νόσος, the word for disease, and then this noun was left out and understood, so that such words as arthritis and nephritis mean disease of the joints or disease of the kidneys, and etymologically there is no ground for taking the word as implying inflammation in particular. Nevertheless, this narrower connotation has its advantages, and it has obviously come to stay.

In an attempt to approach the problem, I have studied the post-mortem reports of almost seven hundred routine necropsies performed in the Queen's University Pathology Department, under the direction of Professor J. H. Biggart, from 1938 to 1942. These reports give not only the naked-eye appearances, but the results of histological examination of the principal organs of the body. I found that 155 cases had shown evidence of pathological change in the heart, and with the kind help of Professor Biggart, I have considered these in detail and have tried to classify them in the light, not only of their pathological findings, but with reference to the clinical data available. It was not



always easy to be certain of the reason why death had taken place, or how the case should be classified; and it was particularly difficult in many of the cases which showed coronary disease. This has been well expressed by Kaufmann, who said that "a pathologist looking at two hearts similarly involved in coronary sclerosis with secondary myocardial fibrosis cannot tell in which case there has been a stormy clinical upset and in which case the symptoms have been mild and latent." Sometimes there was an embarrassment of richness of pathological change, so that one wondered why the patient had lived so long, and sometimes very careful search failed to show why the patient died. The table which follows [next page] shows how the cases were distributed.

It will be seen that almost one-third of these cases were carried into hospital dead, and as they present some points of interest, I shall consider these separately.

The ward cases do not, of course, represent in true proportions the incidence of myocardial disease in the community, for at least three reasons:–

(a) The hospital does not take cases of the infectious fevers.

(b) Relatively few children are included, and

(c) Because of the prejudice which still exists amongst the public, post-mortem examinations are not made in every case, but naturally are more frequently obtained in doubtful or difficult cases, and conversely when the clinician is confident that he knows exactly what happened, he is less likely to press for a necropsy.

HOSPITAL IN-PATIENTS.

| | Each | Total |
|---|---|---|
| Coronary arteriosclerosis | | |
| (a) with infarction | 14 | |
| (b) with ventricular failure | 6 | 20 |
| Hypertensive disease ... | | 18 |
| Rheumatic carditis | | |
| healed | 15 | |
| active | 1 | 16 |
| Toxic myocarditis | | |
| (a) in goitre | 1 | |
| (b) in respiratory disease | 9 | |
| (c) in septic surgical conditions | 5 | 15 |
| Acute bacterial endocarditis | | 12 |
| Endocarditis lenta | | 12 |
| "Brown atrophy degeneration" | | 8 |
| Fatty heart | | 5 |
| Syphilis of aortic valves | | 3 |
| "Monckeberg" disease of aortic valves | | 2 |
| "BeriBeri" heart | | 1 |
| "CARRIED IN DEAD" | | 43 |

THE CLASSIFICATION OF MYOCARDIAL DISEASE.

Various classifications of myocardial disease have been suggested. One of the most satisfactory is that given by Madelaine R. Brown of Boston in 1932, based on one thousand consecutive post-mortems in which 110 showed myocardial fibrosis.

MADELAINE BROWN'S CLASSIFICATION.

(1) Focal infectious myocarditis.
  (a) Acute.
  (b) Chronic.
(2) Toxic myocarditis.
(3) Interference with blood-supply.
  (a) Thrombosis or embolism.
  (b) Ischaemic necrosis from slow reduction of blood-supply.

Before reading Dr. Brown's article, I had attempted a classification on similar lines, but with more details.

CLASSIFICATION OF MYOCARDIAL DISEASE.

*Infective.*
(a) Specific:
  1. Rheumatic.
  2. Tuberculous. Rare
  3. Gummatous. "
(b) Non-specific:
  1. Toxic, e.g., diphtheria and other fevers.
  2. Septic, e.g., in septicaemia and in association with bacterial endocarditis.
  3. "Isolated" myocarditis.

*Degenerative.*
  Fatty infiltration.
  Fatty "replacement."
  Brown atrophy.
  Endocrine (e.g., myxoedema).
  Avitaminosis ("beri-beri" heart).

V*ascular.*
  Coronary:
  1. Ischaemia.
  2. Infarction.
  3. Fibrosis.

MYOCARDITIS.

Of the true myocarditides much the most important is the rheumatic type, of which the Aschoff body is the pathological trade mark. It was present in its various phases in each of the cases classified as rheumatic in this series. In one case of thyroid disease with toxic changes in heart-muscle there was mitral stenosis, but there were no Aschoff bodies. (In three other "thyroid" deaths no recognizable changes in heart-muscle were found, and they were therefore excluded.)

In the two cases of death from tuberculosis which showed myocardial change there was nothing "specific" of tuberculosis found. No case of syphilitic myocarditis without aortic, valvular, or coronary disease was encountered. Diphtheria is notoriously associated with cardiac symptoms and signs, at first apparently of toxic type, giving rise to necrosis of muscle fibres, and later causing chronic inflammatory changes of perivascular distribution. Many other fevers may produce myocarditis, but apart from transient toxic effects true myocarditis is apparently not very common.

In septic conditions the heart may suffer infection: in the cases here recorded this seemed to have happened most frequently in abdominal sepsis, a point of some importance to surgeons.

Under this heading may be classified acute bacterial endocarditis and subacute bacterial endocarditis. In the former the heart-muscle typically shows multiple minute abscesses often with clumps of bacteria; while the latter often shows the Aschoff nodules and fine fibrosis of an antecedent rheumatism with a varying degree of infiltration by inflammatory cells, embolic in origin.

A very full account of myocarditis is given by Otto

Saphir of Chicago in the Archives of Pathology. In this he makes a convincing case for the existence of "Isolated" myocarditis, "a term which denotes more or less diffuse inflammatory changes in the myocardium of wide variety and of various causes, having in common principally an isolated involvement of the myocardium by a non-specific lesion without inflammatory changes of the endocardium or pericardium." The changes are non-specific, and therefore pure rheumatic myocarditis without endocarditis or pericarditis is excluded. It may be rapidly progressive and culminate in sudden death, but there appear to be no characteristic clinical criteria.

DEGENERATIVE DISEASES OF THE MYOCARDIUM.

In the degenerative group, five cases showed fatty heart: these were regarded as fatty infiltration where there were heavy deposits of fat between the muscle-cells, and two showed apparent replacement of muscle-cells by fat. It is not only the obese who may have this latter change, as in wasting diseases the cardiac fat is late in being sacrificed.

Brown atrophy is not regarded as being of great significance, but is a common finding in wasting diseases; six of the eight cases occurred in the cachexia of cancer, one in severe anaemia, and one in a case of duodenal ulcer. This again may be of importance to the surgeon who is contemplating operation on a debilitated subject.

MYOCARDIAL DISEASE OF VASCULAR ORIGIN.

Patients who died in the wards with evidence of coronary or hypertensive disease in whom a complete post-mortem examination had been made, numbered thirty-eight, and I have classified them as follows:–

HOSPITAL ADMISSIONS.

CARDIAC INFARCTIONS.

Multiple infarcts – 9 cases. Of these, one heart showed evidence of syphilis and one showed typical "Aschoff" rheumatic lesions. Eight were large hearts: average weight 20 oz. In three cases there were slight arterial renal changes, but arteriolar changes were *not* a feature. One heart (not weighed) was "of normal size"; the kidneys showed arteriolo- sclerosis.

Single acute infarct – 2 cases. In neither case was renal arteriolo-sclerosis found.

Cardiac infarction with death from heart failure – 3 cases. One was a diabetic with a history of past hypertension, and renal arteriolo-sclerosis was present. In the other two, the arterioles were normal; in one of these a pulmonary infarct determined death.

Coronary arterio-sclerosis without infarction – 6 cases. It is probable that death took place from left ventricular failure. Of these six, four had diabetic histories.

HYPERTENSIVE DISEASE.

Death from cardiac defeat – 11 cases. Nine hearts showed coronary sclerosis, but no actual occlusion or infarct. Two showed no coronary change. All had large hearts; the average weight was 19½ oz. One heart showed evidence of syphilis. All showed definite renal arteriolo-sclerosis. (In one case there were renal calculi with gross destruction of renal tissue.)

Death from cerebral catastrophe – 6 cases. The coronary arteries showed slight atheroma. All six hearts were large: average weight 21 oz. All cases showed renal arteriolo-sclerosis. (One case was diabetic.)

Death from renal defeat – 1 case. The blood-urea rose from 107 to 471 mgm. per cent. before death from uraemia.

It will thus be seen that the relationship of disease of the blood-vessels to disease of heart-muscle presents several problems, but before considering them I should like to tell you more about the pathological findings in those persons who were already dead when brought to hospital. Unfortunately, in this group we have no clinical histories apart from such bald statements as "dropped dead at work" or "felt weak and died in a few minutes." I make the suggestion that hospital authorities should try to obtain clinical histories from the relatives in such cases. It would have been helpful too if the bodies had been weighed, because the weight of the heart is normally proportionate to the weight of the body as a whole. This relationship is shown in Muller's table, here reproduced from Hewlett's textbook and corrected into pounds and ounces.

MULLER'S TABLE.

| BODY-WEIGHT | | HEART-WEIGHT | |
|---|---|---|---|
| 10 kilos | 22 pounds | 28.9 grams | 1.01 ounces |
| 20 " | 44 " | 78.0 " | 2.73 " |
| 30 " | 66 " | 133.5 " | 4.67 " |
| 40 " | 88 " | 193.3 " | 6.76 " |
| 50 " | 110 " | 230.2 " | 8.05 " |
| 60 " | 132 " | 264.3 " | 9.25 " |
| 70 " | 154 " | 297.2 " | 10.4 " |
| 80 " | 176 " | 322.3 " | 11.28 " |
| 90 " | 198 " | 359.0 " | 12.56 " |
| 100 " | 222 " | 376.3 " | 13.17 " |
| 110 " | 242 " | 358.5 " | 12.54 " |

In the tabular statements which follow I should like to draw your attention to the weights of the hearts and to the presence or absence of renal arteriolo-sclerosis.

Only three bodies were female; of the males one was a boy of 13 years; of the remaining males the average of the ages recorded in twenty-three cases was 58, but in the remaining cases the age was not known, and the bodies were described as middle-aged or elderly. No case of death obviously due to injury was included. In twenty-nine of forty-three cases coronary disease was the cause of death. The other deaths were as follows:—

CARRIED IN DEAD.

Cases with no evidence of coronary disease.

Acute diphtheria (heart showed no microscopic pathological change) — 1

Monckeberg type of aortic disease with L.V. hypertrophy. Heart weighed 18 oz. — 1

Dissecting aneurysm of aorta — 1

Hypertensive disease with cerebral thrombosis. Heart weighed 16 oz. — 1

Cardiac hypertrophy of unknown origin. Valves, coronary arteries, and renal arterioles normal, but heart weighed 20 oz. — 1

No cause of death found — 2

CARDIAC SYPHILIS.

Aortic aneurysm — 1

Aortitis with narrowing of coronary ostia and cardiac fibrosis — 2

Aortitis with multiple small cardiac infarcts of various ages — 1

CARDIAC INFARCTION.

Multiple infarcts of various stages old and recent — 13

All hearts were above normal weight of 11 oz. or 310 gm., except one of 10 oz. (283.5 gm.). The average heart-weight was 20 oz. In two cases an infarct had led to rupture of the left ventricular wall. Only one body showed arteriolo-sclerosis of renal vessels. Usually one could distinguish clearly which had been the latest and fatal lesion, but in some cases it was less easy because of the number of infarcts and the extent of the resultant myomalacia.

Cardiac infarction of a single vessel — 7 cases. Of these hearts, five were of normal size; two showed hypertrophy, but one had mitral stenosis. No case showed renal arteriolo-sclerosis.

CORONARY DISEASE, BUT MODE OF DEATH UNCERTAIN.

(a) Gross atheroma of coronaries without complete occlusion or thrombosis; renal arterioles normal. Heart-weights 16 oz. and 15 oz. — 2

(b) Gross atheroma of A.D. branch of L.C. artery; renal arterioles normal. Heart-weights 12 oz. and "slightly enlarged" — 2

(c) Gross atheroma of A.D. branch of L.C. artery; renal arterioles normal. Heart-weights 10 oz. — 2

(d) Gross atheroma of R. and L. coronary arteries, with almost complete occlusion. Renal arterioles normal. Heart-weight 8 oz. — 1

Hypertensive disease — 2

Heart-weights 24 and 18 oz. One heart showed an old healed infarct. Both cases showed typical renal arteriolo-sclerosis and some atheroma of the coronary arteries. It is presumed that death took place by acute ventricular failure.

The carried-in-dead cases may be summarized as follows:—

Non-coronary — 7

Cardiac syphilis — 7

Multiple infarcts — 13

Single infarcts — 7

Coronary disease with mode of death uncertain — 7

Hypertensive disease — 2

Even on this relatively short series of cases it may be argued:

(a) That coronary disease is the commonest cause of sudden death.

(b) That many persons sustain repeated attacks of infarction before the fatal one.

(c) That a first and only infarct may be immediately fatal.

(d) That death may occur before a patient can reach hospital without an actual infarct being detected even on careful search at necropsy. The mechanism of this process is uncertain; presumably it may be duetto acute anoxaemia, with or without the development of ventricular fibrillation. It has been suggested that hypertrophied muscle may demand a greater blood-supply than can be delivered by the narrowed arterial system, and alternative possibilities are chemical changes in glycogen or in potassium metabolism, or that death has occurred by peripheral vascular failure.

(e) That renal arteriolo-sclerosis was rarely found in association with coronary disease.

(f) That hypertrophy of the heart, particularly of the left ventricle, is present in most but not in all cases. The cause of this hypertrophy is considered by several authorities to be hypertension. For example, Clawson considered hypertension to be the most common condition associated with coronary sclerosis, although he found that sudden death was commoner in his nonhypertensive group; he found that hypertrophy in coronary disease was apparently the result of hypertension. In collaboration with Bell,l he found that two-thirds of all clinical cases of coronary

> disease were associated with hypertension. Similarly, Parkinson found that in two hundred cases of coronary thrombosis, the heart was enlarged in 64 per cent., and of these 128 cases, hypertension was the predominant or single cause of the enlargement in 106 (or 82.8 per cent.). He found, however, that in 8.6 per cent. no proof of antecedent hypertension could be made, and that it was probable that the cardiac enlargement was due to cardiac infarction. It is manifestly impossible, in almost all cases, to say whether persons carried in dead to hospital have had high blood-pressure readings or not, and one is tempted to regard cardiac hypertrophy without valvular disease as conclusive evidence of antecedent hypertension. There is, however, another pathological criterion, for Fishberg states: "Lesions of the arterioles are far more closely associated with protracted hypertension than is arterio-sclerosis of the large vessels. Isolated cases of chronic hypertension with neither arteriolar nor renal lesions have been described by various authors. But it is evidently very rare for such a case to come to necropsy, and it would seem . . . that the existence of hypertension for any considerable period can usually be read in the arterial walls." In his own cases of death from hypertensive disease, he found arteriolo-sclerosis of the kidney in 100 per cent. and of the other organs in varying incidence from 3 per cent. in the myocardium itself to 66 per cent. in splenic^arterioles. Bell and Clawson found that renal arteriolo-sclerosis was present in 89.4 per cent. of cases of hypertension: they stress that it should be sought in the afferent glomerular arterioles, and suggest that Fishberg "included as arterioles somewhat larger vessels than these."

It is difficult to offer any acceptable explanation of the marked hypertrophy in these cases if it was not due to hypertension. Clawson considered the problem and mentions, but only to condemn, two possibilities:

(1) That a compensatory hypertrophy may follow myocardial fibrosis, and
(2) That hypertrophy may follow ischemia.

Is it not possible that true arterio-sclerosis, not confined to the coronary arteries, but diffusely and often apparently erratically distributed throughout the body, may offer sufficient and prolonged overwork to the heart-muscle to account for hypertrophy, even without achieving the very high readings of 200 or more systolic and 130 or more diastolic pressure, which characterises essential hypertension; and that it is the cases with arterio-sclerosis with slight or moderate hypertension, but sufficient to cause cardiac hypertrophy, who develop *coronary* arteriosclerosis and infarction, rather than the arteriolo-sclerosis group with very high pressures and cardiac hypertrophy, but with death more often by ventricular failure, which may be either sudden or gradual?

J. H. Palmer, in a series of 212 patients who survived an attack of coronary thrombosis by at least three months, found that 73 per cent. showed evidence of hypertension before or after the attack. (He regarded as hypertension pressures of 160 mm. systolic and/or 100 mm. diastolic.) In sixty-six patients the blood-pressures before the attack were known, and the averages were 170/100. In forty-five, hypertension was found, and in sixteen cases the systolic pressure was 200 mm. or higher. Thus, of the sixty-six persons, 32 per cent. had no hypertension, 44 per cent. had systolic pressures between 160 and 200, and 24 per cent. had systolic pressures above 200.

J. T. King expresses the view that the "incidence of coronary disease and thrombosis amongst patients with marked hypertension is not striking," but suggests that "the coincidence of moderate hypertension and coronary disease is such as to suggest a common aetiologic background for the two conditions."

As I have said, the mechanism of coronary catastrophe is not always easy to reconstruct even after death, and, as Henry Moore has proved by his researches on bundle branch block, the painstaking search of serial microscopic sections may be required. The sequence of events may be outlined as follows: One or more branches of the coronary system undergo sclerosis. This may be part of a generalised arterio-sclerosis, but not infrequently the radial and retinal vessels are unaffected and renal function is unimpaired. One coronary branch may be so severely sclerosed as to be completely occluded, with little or no change in the others; the vessel most commonly involved in our series was the anterior descending branch of the left coronary artery. (In four cases this vessel was double from its source, and one branch was much more sclerosed than the other.)

No case of auricular infarction was found such as has been described by E. H. Cushing and others.

When coronary sclerosis becomes established in

any part of the heart two things happen: first, the muscle supplied by that vessel undergoes a fine fibrosis; and secondly, there begins to be opened up an alternative anastomotic vascular system, but only when the affected vessel is inadequate to supply blood to its original allotment of heart-muscle. This anastomosis is not apparently a natural age change (unless you regard arterio-sclerosis as a natural age-change rather than a pathological process).

Blum, Schauer, and Benson have shown that in experimental ligation in dogs' hearts, anastomoses arise in less than five weeks. With sclerosed arteries, the patient may develop anginal attacks analogous to the intermittent claudication of an arterio-sclerotic leg. Or a thrombus may form in one or other of two ways, either at the edge of an atheromatous plaque or by haemorrhage into the intimal layer of the vessel. The latter was found by Nelson to have been common in the same cases as are here reviewed, and he reminds us that the initial haemorrhage may be associated with exertion, and that symptoms may not arise until some hours later when the patient is at rest.

Horn and Finckelstein found that the thrombus had formed on an arteriosclerotic plaque in 37.5 per cent. and by intramural haemorrhage in 62.5 per cent. of their cases.

Not every subject of coronary arterio-sclerosis develops either angina or the syndrome of coronary thrombosis. The fibrosis which results from vascular change may involve the conducting mechanism, giving rise to various forms of cardiac arrhythmia or to heart-block, or it may impair the efficiency of the ventricle, causing congestive heart-failure.

The pathological possibilities may be briefly summarized thus:—

(1) Sclerosis with transient ischaemia.

(2) Infarction with or without involvement of special conductile tissue. This infarction may be repeated.

(3) Fibrosis of muscle, with or without involvement of special conductile tissue, but leading to heart-failure.

### Clinical Classification.

The symptoms and signs of coronary disease may often be correlated to the three main pathological groups, but one must remember that the pathologist sees a final state, while the clinician is frequently concerned with a stage of disease. The three stages may be linked in the same patient and the transitions read in his history, but many factors influence the process. Very briefly to consider each in turn:—

(1) *Coronary sclerosis with angina.*

It is interesting to trace in the cardiological literature of the last thirty years the gradual recession of Allbutt's theory of aortic changes and the increasing acceptance of coronary ischaemia as the essential cause of angina pectoris, and it is now generally accepted that true angina does not occur in persons with normal coronary vessels. But angina pectoris is a disease which derives its name from a symptom, and interpretation of a symptom is not always easy. This is notoriously true in the case of the patient who minimizes his symptoms in the hope of a favourable verdict and also in the case of him who, often possessed of a dangerous amount of knowledge, exaggerates or misconstrues his symptoms. A diagnosis of angina pectoris should not be made lightly. As was said many centuries ago: "Things not known to exist should not, unless it is absolutely necessary, be postulated to be existing." It is unfair to postulate disease of the coronary arteries unless the full facts make it necessary. There are other causes than angina of chest pain; and conversely, Spillane and White remind us that Heberden, Mackenzie, Osler, and Allbutt all recorded cases of pain in fingers, hands, or arms without substernal pain, and they themselves record twenty-five cases where chronic pain in one or both shoulders (usually the left) preceded or followed the onset of angina or coronary infarction. Physical signs may be misleading, but X-ray evidence of hypertrophy without valvular cause may confirm other evidence of arteriosclerosis or essential hypertension. Electrocardiograms were found to be normal in one-third of Bourne's cases, and Parkinson and Bedford, Riseman, and, recently, many others have found that during, and soon after an attack of pain, the electrocardiogram may approximate to that of coronary infarction.

Trinitrin has been used for many years, and the clinical researches of Hoyle and Evans have shown:—

(a) That the tablets must be fresh.

(b) That they should be chewed quickly for the relief, and slowly for the prevention, of an attack; and

(c) That repeated doses are not injurious.

It is sometimes helpfully confirmatory, but it is not completely reliable as a means of diagnosis: when a patient says that his pain is relieved by trinitrin, it is not proof that he has angina pectoris. I have for many years advised at least a month's complete rest in bed, and this is advocated by Hoyle and Evans and by Fishberg. But I think that one should refrain from the facile diagnosis of "a tired heart," even if one prescribes rest.

(2) *Coronary sclerosis until infarction.*

The angina of effort may be a forerunner of

infarction or may follow in its train. The characteristic difference in the two syndromes were clearly outlined by Parkinson and Bedford in 1928.

These differences depend mainly on the fact that the former is a transient if recurrent phenomenon, and the latter is due to acute structural change, the manifestations of which vary in different individuals. Pain is almost invariably present: it may be agonizing, or it may be relatively slight and masked by the predominance of another symptom or attributed to another cause. Thus it may be blamed on flatulence or "acute indigestion," or on the strain of vomiting. It is also possible that the morphia administered for its relief may blot out the memory of the pain, and thus cause the patient to deny or minimise it afterwards. J. B. Herrick gave an interesting explanation of those cases in which it is absent in these words: "At autopsy, fresh infarcts are sometimes found associated with multiple areas of fibrosis that speak for previous obstruction of small branches, yet no pain has been noted, no pain even announcing the present infarction. There has evidently been a very gradual and progressive narrowing of the artery by sclerotic processes. The area irrigated by the artery has become relatively inactive, relatively anaesthetized by the destruction of vessels, nerves, and functioning muscles, so that a painful response to a new obstruction is lacking. The final complete obstruction comes without any sudden shock, the element of surprise is lacking, as the heart is in a sense prepared for the supreme insult." Abrupt heart-failure may be present, but pain is absent, and dyspnoea may be the pain equivalent.

An infarction not infrequently produces auricular flutter, or fibrillation, or even ventricular fibrillation, or heart-block, or bundle-block, and the underlying cause may be overlooked. Conversely, paroxysmal flutter or fibrillation, which are of more benign prognosis, may be thought to be due to an acute infarction, but here the history of the patient and the absence of collapse are useful.

When the pain is epigastric or even abdominal, the presence of liver-dulness and the absence of true abdominal rigidity may prevent a mistaken diagnosis of perforation of a hollow viscus. Only in one post-mortem case in the Royal Victoria Hospital series of coronary lesions was a diseased gall-gladder found, but the gall-bladder may occasionally simulate or exacerbate pain of coronary origin. Acute pneumothorax may be detected by careful examination and confirmed by the X-ray screen. Pulmonary embolism presents a most difficult problem, and as Wood has shown, may be distinguished by electro-cardiograms with special chest-leads.

In the case of dissecting aneurysm the onset is even more abrupt, the pain is still more severe and more resistant to morphia; it extends to the back and the abdomen, and frequently leads to obliteration of the pulse in the limbs.

Coronary infarction usually presents electrocardiographic changes typical of the condition. There are two main types indicating anterior and posterior lesions. Serial electrocardiograms show a tendency to revert to normal, but commonly the patient is left with an inversion of a T wave. Katz has catalogued the list of causes of inversion of T, including coronary lesions, experimental and clinical, toxaemias of specific fevers, uraemia, and the effects of quinidine, digitalis, epinephrin, and insulin. Another cause is pericarditis. Occasionally the standard limb-leads may show no change after an infarction, but chest-leads show typical changes.

Blood-pressure does not always fall during an attack, but when it does it may remain deceptively low. Thus, hypertension may be followed by pressures which are apparently normal, a condition which led Donzelot to an apt phrase when he spoke of "le coeur camouflé."

The treatment of the syndrome of infarction is rest and morphia. The late J. E. Macllwaine taught that the patient's period of maximum danger is during the pyrexia which follows the onset (and which is of diagnostic significance). We were formerly taught that a daily enema was better than laxative medicines, but it is safer to neglect constipation during this early stage. Oxygen is grateful to some patients, even when cyanosis is slight. Digitalis is indicated when auricular fibrillation is present or when congestive heart-failure occurs, and must be given cautiously. As a general rule, it may be said that the patient should be six weeks in bed and four months on the same floor.

Parkinson estimates that the chances of recurrence are one in four, and Palmer found that of patients who survive three months or more after the first attack, almost 75 per cent. may be expected to be alive five years later, and almost 40 per cent. ten years later. The average death-rate from year to year was, in the cases he reviewed, 6 per cent. for the first five years and 12 per cent. for the second five years.

(3) *Coronary sclerosis until fibrosis of muscle.*

Patients with coronary sclerosis may develop multiple areas of fibrous tissue as the result of repeated infarcts, which may not have been recognised during life; or the process may be a fine fibrosis diffusely involving the area irrigated by the

branches involved. In either case the patient's symptoms are those of myocardial inefficiency, with breathlessness as the herald of congestive failure. Of recent years, increased attention has been given to left ventricular failure with its sequence of nocturnal dyspnoea, cardiac asthma, and pulmonary oedema, and the dramatic effect of morphia in this condition has been more widely recognised.

Many cases which begin as left ventricular failure rapidly merge into "combined" failure with congested liver and distended veins.

When the disease-process has involved special conductile tissues, there is interference with normal cardiac mechanism. Auricular fibrillation is common and is frequently of less grave prognosis when it arises from this cause. Heart-block of its various types, including bundle-branch block, may occur. This last form is interesting: first, because of the changes in nomenclature; in recent years what was thought to be right bundle-block has been proved to be right; and secondly, because a less gloomy view of its prognosis has been expressed by various writers. For example, Bishop and Carden say that the character and degree of the attendant heart disease are the principal factors in determining prognosis, rather than the presence or absence of bundle-branch block.

No such alleviation has been offered in the presence of two physical signs which are more easily recognised. The first of these is gallop-rhythm, which, as Bramwell has shown, occurs most commonly when a feeble ventricle is beating rapidly against a peripheral resistance which is too high for it, and tends to disappear when the pulse-rate subsides. The other is pulsus alternans, which is demonstrable with the sphygmomanometer. It has been suggested that the greater the gap in the pressure-levels of alternate beats, the worse is the prognosis (Reginer).

In conclusion, may I remind you that the pathological evidence here reviewed serves to emphasise the importance of disease of the arteries as a cause, not only of sudden death and of the syndromes of angina pectoris and cardiac infarction, but also of fibrosis of the myocardium. But it offers no explanation of the cause of arterial disease or the hypertension which so frequently accompanies it. In this field of medicine, as in many others, diagnosis has outrun therapy. It is a solemn thought that if Queen Anne's army had had the distinguished services of our modern R.A.M.C., a young officer called John Churchill might, I am afraid have been invalided out with a diagnosis of essential hypertension, to languish in Bath or Cheltenham on half-pay. Thus they would have robbed him of Blenheim and the dukedom of Marlborough, and Britain of her greatest general.

Finally, I thank you for your patience, and my colleagues, especially Professor Biggart, for their help and access to their records.