THE LETTSOMIAN LECTURES ON DISEASES AND DISORDERS OF THE HEART AND ARTERIES IN MIDDLE AND ADVANCED LIFE.*

Delivered before the Medical Society of London.

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LECTURE I.

SCOPE OF LECTURES.

THE problem of the diseases and disorders of the heart and arteries in middle and advanced life may be said to come before the family practitioner every hour of his work, and to present difficulties and create a sense of responsibility or even anxiety which are not sufficiently appreciated by the hospital physician. There comes before him the case of one of his patients, an active business man of 45, who has been seized with angina pectoris when hurrying to the station after breakfast; or that of an old friend whose proposal for an increase of his insurance at 50 has been declined because of arterial degeneration and polyuria; or he is asked to say whether a man of 60, occupying an important and possibly distinguished position in the community, ought to retire from public life because he has occasional attacks of precordial oppression and a systolic murmur at the base of his heart. What, again, is he to do for the stout, free-living man, just passing the meridian of life, who consults him for weakness and depression, whose heart is large and weak, and the urine saccharine and slightly albuminous? There is not one of my audience who has not met with such cases as these many times in his practice, and a variety of other cases of cardiac disorder and disease after 40, where the importance of the individuals, the value of their lives, and the gravity of their complaints and their prospects have exercised him very anxiously. What is the prognosis in cases of this order? What can be done for them in the way of treatment? These are the questions which we would desire to answer usefully. The answer, it seems to me, can be given only after an analysis and study of a considerable number of instances of the kind, in respect of their origin, their clinical characters and course, and the result. This is the method of inquiry which I propose to follow. It will be a study of cardio-vascular disease in older subjects from the clinical point of view, but it will be approached not only from the ordinary clinical side as it is approached in hospitals, that is, by an investigation of symptoms and signs, but also and especially in the light of that particular order of knowledge which the family practitioner has learned to appreciate and has so intimate and correct an opportunity to acquire—a knowledge of the origin or causes of the different affections, which it is always difficult and often impossible for the hospital physician to ascertain, and which he is perhaps apt to ignore. For the same reason, although, to be complete, a study of the diseases of the circulation at and after middle life should include an account of the *post-mortem* characters found in fatal cases, and whilst the basis of the account I submit to you will be essentially pathological, I shall not attempt to describe the pathological anatomy and histology of senile and other lesions of the heart and arteries. This part of the subject has been remarkably advanced during the last few years; and even if I had the time and the necessary knowledge to deal with it now, I should have nothing original in it to lay before you. Indeed, if I may venture to say so, our attention lately has been too much confined to the pathological states of the heart and arteries and too little directed to the causes which produce them. "Arterial sclerosis" is now an ordinary diagnosis in everyday practice, as if it were sufficient for purposes of prognosis and treatment to have determined that the radial artery is thicker and longer and more dense than normal without regard to the actual nature of the pathological change, whether strain, syphilitic, or gouty, or otherwise. And in the same way the phrase "dilatation of the

heart" is now in everybody's mouth, irrespective of considerations of its origin. Not only has the profession suddenly woken up to the recognition of a form of enlargement of the heart which was fully described fifty years ago by physicians in our own country, but the public have made "dilated heart" a fashionable disease which calls for the advice of a specialist and an annual visit to a Continental spa. We ought to have advanced beyond this stage of cardiac pathology long before this time. Besides, of how much greater interest is it in our everyday work to study causes or the circumstances that lead up to disease than the simple state of disease itself; and there is in study of this kind an opportunity afforded to the family practitioner of advancing medicine—scientific, preventive, and therapeutical—as surely as if he were a pathologist in the *post-mortem* room or theatre.

THE NORMAL HEART AT THE AGE OF 40.

Before, however, examining the influences and circumstances which disorder and damage the circulation in middle and advanced life, let us see what the normal or natural state of the heart and arteries is after 40. It has been ascertained that the different parts of the circulatory apparatus pass through certain definite phases of change in the different stages of that decline of existence and energy which leads to senility and ends in death. We have to thank Professor Beneke of Marburg for the results of a laborious investigation of this subject, which are generally accepted, and which I will attempt to summarise.¹

We should all expect the cardio-vascular system to undergo important changes with increasing age; but few of us would be prepared to find that these changes are neither uniformly progressive nor progressive in the same direction. To make more easily intelligible the nature and, as far as possible, the origin of these anatomical alterations in the heart and arteries during the second half of life, I will first refer for a moment to the circulation from 20 to 45. During this period of life the blood pressure is relatively high (reaching its maximum about 36); the aorta and other large arteries increase in diameter from the stress of the blood pressure on their elastic walls, particularly between 35 and 45; and the heart increases in size year after year at a nearly uniform rate. We have in these facts anatomical evidence of the great functional vigour and activity of the circulation in manhood. At 45, which is practically the commencement of the period with which we are concerned, remarkable changes occur. Whilst the arteries continue to increase in circumference (somewhat more slowly than before), the blood pressure falls and the heart begins—almost suddenly—to diminish in size; and these three features characterise the circulation for the next twenty years—that is, until the age of 65. How is this fall in the size of the heart to be accounted for? Partly by the widening of the arterial trunks and the consequent fall of pressure. But not by these only; for, although the arteries had been widening even more rapidly between 20 and 45, the pressure was actually at its maximum then, and the heart large; and we shall presently find other facts opposed to this view. The peripheral resistance in the systemic arteries must fall from some other cause or causes in middle age than the loss of elasticity of the arterial walls; and these causes are probably reduction of mechanical stress, due to comparative bodily relaxation, loss of vasomotor tone in the splanchnic area, and the chronic diseases of which the subjects have died whose hearts and vessels are measured *post mortem*. During this phase of life, also, the blood becomes more venous in quality, and its hæmoglobin value is lowered.

At 65, other changes which occur in the heart and arteries are not less striking than those which I have just described. The decline of circulatory energy and of the effects of time itself on the protoplasm of the cells of the body have so lowered the metabolic and functional energy of the tissues and organs and the activity of the blood supply that a considerable proportion of the capillary network becomes obsolete. The peripheral resistance is thus increased; the blood pressure rises; therefore the heart once more increases so much in size that at the end of the ten years (age 75) it is found as large as it was at 45, and at the same time the hæmoglobin value of the blood again proves to be higher. During this period also the arteries continue to grow wider and thicker and longer—another

* A few passages are omitted from the text of the lecture as delivered.

proof that the size of the heart is not determined solely by their calibre. Regarded as a whole, the process of senescence of the cardio-vascular system presents to us a beautiful instance of anatomical readjustment and compensation, the counterpart in a way of the growth of the circulation in energy and activity during the period of full manhood. The arterial walls, which have been stretched in their diameter and in their length by exhaustion of their elasticity under the stress of cardiac systole, are strengthened afresh by the development of staves formed of fibroid tissue in the intima and media, and the heart responds to the altered mechanical condition ahead of it in the arteries, and to the increased peripheral resistance caused by the obsolescence of many capillaries, by growing afresh.

This account relates to the size of the arteries after 40; now let us inquire what is the condition of their structural elements. The changes described do not necessarily involve disease of their tissue elements, unless we are to call every senile change morbid.

My friends Dr. Bosanquet and Dr. Mullings have given me an account of the state of the heart and aorta in the bodies of 25 men aged 40 and upwards who died from accident or suicide. The average age was 53½ years, and the aorta presented some degree of atheroma in half the cases. When we consider how very slight a change in the arch of the aorta is habitually described as "atheroma," and that in a few of the cases the valves were diseased and the heart enlarged, we are justified in concluding that in the majority of persons of 53 the arteries are still sound. This result is in accord with that obtained by Professor Humphry, who devoted his attention so long and so successfully to the investigation of old age. He states that in the great majority of cases the arterial system appears to present a healthy condition in those who attain to great age.² Even among the majority of centenarians the evidences of arterial degeneration were not manifest.³ And we know that we occasionally meet with people of 80 and upwards whose radial arteries are unexceptionable beyond presenting a trace of thickening and enlargement. For my present purpose, therefore, we may conclude that as age advances the arteries naturally become wider, longer, and thicker, and altogether larger than in early life, and that we must not speak of "vascular degeneration" in an evil sense as often as we find these conditions present. As for the heart, we know that it may remain structurally sound, and is more often regular than irregular, to the most advanced years of life. Conversely, these facts suggest that actual diseases of the arteries and heart—that is, other than the changes which are found in all persons after 45, are not properly senile in their nature. As Professor Humphry said, they are no part of, but are rather to be regarded as deviations from or morbid departures from, the natural phenomena.⁴ They must be the effects of pathological processes due to a variety of pathogenetic influences which assail the circulation. We are now in a position to study these, and along with them certain natural provisions possessed by the organs of circulation for resisting them and for recovery from their actions and effects, as they so often and so successfully do.

INJURIOUS INFLUENCES IN MIDDLE LIFE.

After the age of 40 many of the influences that threaten the heart and arteries with disorder and disease are peculiar to this period of life—that is, different and distinct from the causes of cardiac and vascular affections in childhood, adolescence, and manhood; others of them have been encountered already with or without permanent damage as the result. I will now examine them in detail, and at the same time refer to certain provisions with which the heart and arteries are endowed for resisting them and recovering naturally from their effects; and the circumstances which render these provisions abortive or insufficient, and thus predispose to disease or indirectly determine its occurrence.

1. *Physical Stress.*

This is still a definite cause of cardiac and vascular damage in the second half of life, in the forms both of sudden violent exertion and of ordinary laborious occupations. I have met with instances of acute and serious strain at all ages over 40, up to and even after 70. I am aware that I must speak on this part of my subject—the evil effects of muscular exercise

—with caution. But I feel sure that it will be agreed that when the man of 65 rushes from his breakfast table to catch his train, or the lady of 70 hurries up a hill in Wales to be in time for morning service, or the middle-aged father on holiday, who has just taken up the bicycle to reduce his weight, takes the pace from his son of 17, the effect on the heart and arteries is likely to be serious. I have notes of many cases of cardiac strain in middle-aged and old persons from cycling; a very few from violent efforts to drive at golf; a few from efforts at lifting or resisting heavy weights; and one notable case in which a member of our own profession, a man of 45, belonging to the R.A.M.C., broke down with acute cardiac dilatation during General French's memorable ride to relieve Kimberley. In some of my cases there was no reason to believe that the heart was other than sound before the strain; but in a majority of them—and I have analysed 40 of which I have more or less full notes—one or more of the safeguards of the circulation against strain were already defective or wanting. What are these? In the heart, chiefly a high degree of extensibility or elasticity of its tissues, permitting over-distension of the chambers, with safety-valve action of the tricuspid in extreme cases, and a sound and vigorous musculature to effect the increased action, and if necessary the hypertrophy which mechanical stress demands—in a word, well-nourished, healthy cardiac walls. It is an interesting fact that two-thirds of my cases of cardiac strain in the second half of life presented also a history of gout, fully developed or irregular—in other words, a history of perverted metabolism. Equally striking is another fact in this connection: that in many cases the occurrence of strain in middle or advanced age was but the latest of a series of similar events as the result of muscular effort for a period of ten, twenty, thirty, forty, or even fifty years. In other words, the heart had been strained originally in youth or early manhood, and had given serious trouble as often as it was taxed again. Rowing or running at college was in a good many instances given as the cause of the first strain. I need not do more than mention previous valvular disease, usually of rheumatic origin, as a condition powerfully predisposing to cardiac injury by physical exertion. Excepting in this indirect way, rheumatism has no effect in lowering the resistance of heart or vessels to mechanical stress.

The principal safeguard which the arteries possess against strain is of course the extensibility and elasticity of their tissues. Unfortunately the metabolic disorders, including gout, which we have just found weakening the cardiac walls, are amongst the commonest causes of arterial degeneration also, and the two influences acting together no doubt are accountable for a considerable number of cases of atheroma and chronic arteritis. It naturally might occur to us that gout and exertion could not well be associated, but this consideration serves to explain their mutual influence in straining the heart. It is unwise, ill-timed, ill-planned muscular exercise that injures the circulation, most often on the part of the middle-aged man, who, awaking to the consciousness of growing fat and gouty, rushes inconsiderately to violent exercise for relief.

2. *Nervous Influences.*

It is generally recognised that nervous excitement taxes the circulation, and endless phrases and expressions, articulate and inarticulate, testify to the universal belief in the close connection between the heart and the emotions. Quite recently Dr. Leonard Hill and Dr. George Oliver have demonstrated instrumentally the rise of blood pressure that accompanies cerebral activity. No doubt many cases of disorder and disease of the walls of the heart and arteries originate in distress, worry, anxiety, and protracted suspense; and the connection is most often seen in middle and advanced life because these depressing emotions fall most heavily upon mankind at this period. Of the instances which I have met with I will mention but one or two by way of illustration. A member of the Reform Committee at Johannesburg at the time of the Jameson Raid, who had been confined in Pretoria Gaol, came home some time afterwards with the ordinary symptoms and signs of fatty degeneration of the heart and died suddenly on the street. A detective officer who had tracked suspects and criminals all over the world, facing great personal danger, and had on one occasion to convey a parcel of dynamite found

near a Government office to a place of safety many miles away, came under my care later on with arterial sclerosis and cerebral thrombosis, for which no other cause but a life of adventure could be discovered. These were cases of actual disease of the heart and arterial system respectively, and I need not add that disturbances or disorders of the circulation, of every variety, the result of nervous excitement or depression, come constantly under our observation, especially in women. I would particularly mention, however, a group of cardio-vascular troubles that lie between these two extremes. I have frequently observed that persons of anxious and energetic temperament, burdened with responsible work of a heavy, constant, and prolonged character, when they break down as they often do, present the clinical features of high tension; the pulse is full, the heart is large, the second aortic sound is loud and ringing, there is polyuria, and a trace of albumen may be found. This disturbance of the circulation, strongly suggestive of contracted kidney, is as common in women as in men—for instance, in matrons of schools or hospitals. Nevertheless, however clear the direct connection between nervous strain and cardio-vascular disease may be in many instances, it is in other instances unreal, or more correctly indirect only. This is a matter of great practical importance. First, the nervous temperament often drives the subject of it to physical overwork in the form of incessant and prolonged devotion to work, with insufficient hours of rest and sleep, and to unwise attempts to remove nervous exhaustion by violent muscular exercise. In the second place, alcohol undoubtedly plays an important part in many instances regarded as overwork and worry and nervous exhaustion both in men and in women—alcohol taken to enable more work to be accomplished, to steady the nerves, to promote sleep, to drive away care, or to relieve the faintness which it has itself induced. And, thirdly, many of the complaints of nervous depression, lowness, and worry are really due to gout, to influenza and the like, which are at the same time the true causes of the cardiac symptoms.

3. *Extrinsic Poisons.*

What I have just said in connection with nervous causes of cardio-vascular affections brings us naturally to that important group of agents which may be summarily called extrinsic cardiac poisons—alcohol, tobacco, tea, coffee, and lead. I will not dwell on this subject at present, for there is no need to prove the reality of the connection, and I shall have occasion to refer to some of these poisons at greater length under the head of diagnosis. Alcoholic heart occurs both in men and women; tobacco heart is extraordinarily common in our own profession, and common in clergymen and in retired members of the public services; tea, coffee, and cocoa heart I have met with principally in students.

4. *Disturbances of Metabolism, including Gout.*

There can be no question but that these are by far the most prolific cause of cardio-vascular disorder and disease after 40, at any rate amongst the middle and higher classes in this country. This period of life brings with it in many instances comparative relaxation from work, and a disposition to substitute quiet or even passive for active exercise; and whilst the demands of growth and development on the alimentary system have greatly declined, the pleasures of the table and ease generally are too often indulged in as a privilege of advancing years and the legitimate reward of previous years of work. The results are functional disorders of the liver, gout in regular and irregular forms, gravel, and the many associated disorders of the muscular, nervous, and other systems. At the same time the arterial tension rises, for the body possesses a beautiful provision for eliminating the nitrogenous products of metabolism, whether normal or abnormal, namely, the kidneys, the vasomotor mechanism, and the heart. Stimulation of the vasomotor centre by nitrogenous waste raises the arterial pressure; the heart is excited to more vigorous contraction (if necessary it hypertrophies), and the consequent polyuria washes the intrinsic poisons out of the system. Thus it happens that in metabolic disorder from excessive or unwholesome eating and drinking, the heart, vessels, and kidneys are kept under incessant strain; and, like other organs working under strain in the gouty subject, they are the readiest to suffer—first

disorders of many kinds, and ultimately, unless reform be enforced, chronic Bright's disease and cardio-vascular degeneration.

Of the many cases of this kind that I have seen at all ages between 40 and 80 (and others before 40), the proportion of irregular gout to acute articular gout was about 3 to 2. Under irregular gout I include goutiness in its many forms—sick headache, eczema, sciatica, lumbago, acid dyspepsia, irritable bladder, gravel, insomnia, irritability, depression, and the familiar complexion and appearance generally of "the gouty individual," all more or less combined.

In some cases the metabolic disturbances come before us not as gout or even goutiness in the ordinary acceptance of the term, but in the forms of obesity, of glycosuria, of gravel, of irregular albuminuria, and of the effects of large eating and free living in general.

5. *Syphilis.*

This fruitful cause of vascular disease, and both directly and indirectly of cardiac disease, has by no means ceased to attack the organs of circulation after 40. Whatever the date of the primary infection, syphilis is a standing danger to the heart and arteries in the middle-aged man, and even in declining years. Thus, in 11 cases belonging to this group, the average age at which they came under my observation, most of them, but not all, complaining of cardiac distress, was 55. All of these were men. I ought to add that in a considerable proportion of the cases either physical strain, alcohol, tobacco, or Bright's disease, and sometimes more than one of these, were associated with syphilis in the etiology.

6. *Acute Diseases.*

For the man and woman of 40 and upwards, most of the acute specific fevers are affairs of the past. But the liability to several of them remains; and very unfortunately the liability to those acute specific processes which may attack the cardio-vascular system, influenza in particular, and less often typhoid fever, rheumatism, diphtheria, and pneumonia, as well as septicæmia of different forms or kinds which work havoc throughout the entire circulation.

7. *Chronic Diseases.*

I will not occupy your time tracing the origin of certain cases of cardio-vascular disease in middle and advanced life to chronic affections of different kinds. Besides the obvious effects upon the heart, blood, and blood vessels, of anæmia, exhaustion, etc., we meet with such grave lesions as fatty degeneration from pernicious anæmia and other blood disorders, profound circulatory derangements and occasionally disease in Graves's disease, and others.

8. *Complex Causes.*

In addition to the definite and distinct influences which I have mentioned as threatening the heart in this stage of life there are two which, although intimately associated with other causes of cardio-vascular disease, deserve to stand out independently. The first of these is emphysema, and along with it other chronic diseases of the lungs and pleura, which strain the right ventricle; the second is chronic Bright's disease, which similarly strains the left ventricle. I shall have frequent occasion to return to these two morbid states in different parts of my subject; I mention them here to give them the position which they deserve as influences which threaten the function, and still more the structure, of the heart and arteries. This brings me to the many instances in which the different influences that threaten the circulatory organisms in middle and advanced life act together in different combinations. Alcoholism is equally common amongst the poor, whose circulation is subjected to mechanical stress whilst it is impoverished by want; the well-to-do, who lead luxurious, sedentary, enervating lives; and, as I have already observed, the keen, active business or professional man who overworks his brain on stimulants. In this country at least gout appears to be all-pervading, and as an unfavourable influence on heart and vessels it often cannot be dissociated from alcohol, sedentary habits, worry, plumbism, Bright's disease, and emphysema.

Thus in our study of combinations of morbid influences we come to appreciate the evil effect of certain occupations upon the circulation in middle life. The business man is

exposed to the unhealthy influence on his heart of confinement to a close office or shop, worry, irregular hasty feeding, alcoholic indulgence in connection with his trade or profession, and unwise attempts at violent muscular exercise at the week-end or in the holiday season; or he may be guilty of entire disregard of the rules of bodily and mental hygiene, and bring on in this way premature degeneration of his cardio-vascular system. Still more numerous are the causes at work in the production of "soldier's heart." We have but to picture to ourselves, if we can, the physical strain, the mental excitement, the bodily hardships—including exposure to both extremes of temperature—and the coarse fare which have been the lot of many thousands of our brave troops in the Boer war, to understand how the fighting soldier "ages" quickly, and in particular ages in his heart and arteries. Add to these unfavourable influences syphilis, alcohol, and tobacco, which unfortunately must be added in many instances, and the chance of escape from grave disease of the circulation in the soldier is practically *nil*. But the soldier's heart is also met with elsewhere than in the army. The clergyman from the slums, who has lived and toiled and fought with various success through alternate periods of excitement and depression, and has thus suffered much both in mind and body, comes to us with high-tension pulse, a tortuous radial artery, a large heart, and a systolic murmur over the aorta, and complains of an attack of angina. His wife, who has laboured in the parish for years (she is 76 and still active in her work of charity), has also a thickened radial artery, a large heart, and a systolic basic murmur, with no discoverable cause of these evidences of a diseased circulation but the life that she has led amongst the poor around her. Perhaps such cases of cardio-vascular disease might be most correctly said to be due to the wear and tear of life. They are met with also in the traveller or explorer who has spent years of his life in search of adventure; and they are found in a man who has never left home, but whose years have been filled with the toil and anxiety of his position.

Old-Standing Organic Heart Disease.

It is necessary, however, to qualify the above statements in two respects. In the first place the heart and blood vessels may have been so damaged in early life that they fall victims to influences which, whether in kind or in degree, would have been insufficient to produce idiopathic disease of these organs. This brings me to the subject of old-standing valvular disease, mostly rheumatic in origin, adherent pericardium and chronic parietal strain in middle-aged and old subjects. A considerable number of our cases are of this type, and they have to be mentioned here to give completeness to the plan of description, but they are outside the range of our immediate subject. In the second place, the heart and vessels at 40, although to the naked eye free from damage, may be molecularly weak and unable to offer effective resistance even to influences of an ordinary character.

"Family Heart."

I have now arrived at the last, and certainly one of the most interesting, of the causes of disease of the heart and arteries in middle and advanced life, there are some persons whose hearts and arteries cannot carry them through the wear and tear of what may be called everyday life for more than forty or fifty years. The vital energy of their tissues is exhausted prematurely; they are already old at 45; degeneration of their muscle and other cells sets in early, reminding us of primary myopathic paralysis in children. This type of case is described as "family heart," for it also runs in families, three, four, five, or more members of which—as in instances that I have myself observed—may have all died suddenly of cardiac disease, some of them at an early age. Similarly, it is not by any means unusual to find quite young men—say of 30—with vessels already much enlarged; and, I may add, equally young subjects with their lungs already emphysematous, although there is no history of respiratory strain, reminding us of the very common association of emphysema with arterial sclerosis in old age. These cases of family heart and premature arterial sclerosis are the links that connect diseases of the heart and arteries in middle and advanced life of definite pathological origin with the genuinely senile changes in their tissue elements

which render existence untenable at last, and which may be said to be the result of the exhaustion of their nutritional energy by the thousand natural shocks that flesh is heir to.

REFERENCES.

- ¹ *Die Altersdisposition*, F. W. Beneke. ² Humphry, *Old Age*, 1889, p. 23.
³ *Op. cit.*, p. 48. ⁴ *Op. cit.*, p. 15.

THE MILROY LECTURES

ON

THE INFLUENCE OF THE DWELLING UPON HEALTH.

Delivered before the Royal College of Physicians of London.

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LECTURE II.

EFFECTS UPON HEALTH OF CERTAIN KINDS OF DWELLINGS. THERE are no conclusive statistics available in reference to the old type of vertical houses sublet in separate dwellings or tenements, but the inference to be drawn is that they produce an unfavourable influence upon health, and that in houses of six storeys and over the order of mortality from lowest to highest occurs on the first, second, ground, third, basement, and fourth floors.

An investigation into the statistics of Peabody Buildings in London as examples of "flat houses" was made by Dr. Newsholme¹ in 1888-90. He found that their death-rate averaged about 2 per 1,000 lower than that of London during the twelve years ending with 1885. During the four subsequent years the death-rate of the buildings has remained about stationary, while that of London has shown a further decline, thus making the metropolitan death-rate approximate more closely that of the Peabody Buildings.

The infantile mortality is much lower in the Peabody Buildings than for all London. The death-rate from diarrhoea is slightly lower and from enteric fever only half that of the whole metropolis. But diseases more directly due to infection (scarlet fever, diphtheria, and, still more, whooping-cough and measles) are more fatal, and therefore probably more prevalent.

The death-rate from phthisis and other tuberculous diseases is slightly higher in the Peabody Buildings than for all London. The Medical Officer of Health of St. Giles, Dr. Lovett, has kindly supplied me with the records he has kept through a series of 10 years of the population, births and deaths in four large blocks of buildings in St. Giles². Comparing the buildings, St. Giles, and London, from ten years, 1890-1899, the percentage of population under 5 years was respectively 17.0, 10.1 and 11.9 per cent.; the birthrate 37.3, 27.6, and 30.4 per 1,000 of population; the mortality under 1 year per 1,000 births 130, 153 and 160; the death-rate under 5 years per 1,000 population under 5 years 50.7, 76.9, and 65.6; the death-rate over 5 years per 1,000 population over 5 years, 10.4, 16.3, 13.6; the death-rate at all ages per 1,000 population at all ages, 17.3, 21.3, and 19.8; and the death-rate from the seven principal zymotic disease, 3.0, 2.1 and 2.7.

The later investigation in the main corresponds with the earlier, for although whooping-cough comes out much better, measles come out much worse, and the conclusion is confirmed that the diseases due to direct infection are more prevalent in buildings composed of multiple dwellings.

[Reasons were given why a comparison between statistics relating to houses demolished and on an insanitary area, and of new buildings erected on the site would be of little value.]

The association of certain houses with certain diseases is a mode of classification adopted by many investigators. Consumptive houses are amongst this class. Pathogenic investigation has also been extended to pneumonia houses and suspected cancer houses, but they must rather be regarded as suffering from infection remediable more by isolation, disinfection, and cleanliness than by improved construction and usage.

[The effects of certain defects of dwelling-houses on health