LECTURES ON THE PATHOLOGY OF TUBERCULOUS DISEASES OF BONES AND JOINTS.

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LECTURE I.

Characters and Seats of Tuberculous Disease in Various Bones and Joints—Hip, Knee, Ankle and Tarsus, Shoulder, Elbow, Wrist, Ribs, Sternum, Clavicle and Scapula, Flat Bones of the Skull, Bones of the Face, Vertebrae, Sacro-Iliac Synchondrosis.—Evidence that the terms "Tuberculous" Bone and Joint Disease and "Strumous" Bone and Joint Disease are synonymous—from Cases of Accidental Infection, from the Microscopical Structure of the Affected Tissues, from the Presence of Tubercle Bacilli.

MR. PRESIDENT.—In my lectures here last year I described in detail the morbid anatomy of tuberculous diseases of bones and joints, and in the present lectures I propose to continue this subject, and afterwards to consider their etiology. It will be remembered that I laid special stress on the distribution of the disease, and pointed out that, in my opinion, it usually begins at one or more points, and spreads from these points over the rest of the joint, and I also drew attention to the large amount of inflammatory thickening which accompanied even a small amount of tuberculous disease.

I shall now, in the first place, consider as shortly as possible the common seats of the primary deposits, and the usual character of the disease in the various bones and joints, and shall again illustrate the points by photographs made by Mr. Pringle from sections of my own, and also from some which have been kindly lent me by Dr. H. A. Thomson, of Edinburgh. I shall also show a few of the sections which I exhibited last year.

HIP-JOINT.

In the hip-joint, as in all diarthrodial articulations, the disease may begin in the bone or in the synovial membrane, but it is by no means easy to make out the relative frequency of each form in the hip, for the joint is deeply placed, and probably a larger proportion of cases of hip-joint disease recover under expectant treatment alone than of any other of the large joints. In my own cases, at any rate, the great rarity of operative procedures such as excision has presented an accurate determination of this point.

König examined 15 museum specimens at Göttingen, and found that the disease was primarily osseous in 8, and primarily synovial in 7. An investigation of this kind is, however, not a true criterion, because only typical cases, and most probably chiefly cases of bone disease, would be placed in a museum.

Haberern found in 132 cases of excision of the hip which were carefully examined that 80 were certainly primarily osseous, 23 certainly synovial, and 29 doubtful. Blasius, on the other hand, states that primary synovial disease is more frequent than primary osseous disease, and, as regards the femur, he gives the proportion of synovial and osseous disease as 3 to 1.

Of 12 cases in which I have made sections of the bones there was primary bone disease in 5, but I cannot say that in all the remaining cases the disease was primarily synovial, because I had not the opportunity of examining the acetabulum in all instances. My own impression is that while the disease is more often primarily osseous in the case of the hip-joint than in the knee-joint, for example, it begins oftener in the synovial membrane than Haberern's statistics would lead us to believe.

As regards the seat of the primary osseous deposits, most authors agree that they are more frequently acetabular than femoral. In Haberern's 80 cases of primary bone disease, the

acetabulum alone was the seat in 50, the femur alone in 23, and both together in 7. In my experience the proportion of acetabular diseases is much less. In the femur the usual seat is in the lower part of the neck just outside the epiphysal cartilage. In some cases it is further out in the neck of the bone, and even in the trochanter, but it is very seldom that primary deposits are found in the epiphysis itself. In the acetabulum the disease generally commences in the neighbourhood of the Y-shaped cartilage, and in some cases this cartilage may be completely destroyed.

The relative frequency of soft caseous deposits and of sequestra varies much according to the age of the patient, but in any case apparently sequestra are most common. Thus, to refer again to Haberern's work, we find that of 50 cases where the primary seat was in the acetabulum, 31 were associated with sequestra, and 19 were not, while in the femur sequestra were present in 14 and absent in 9, and in the 7 cases where there were primary deposits in both bones sequestra were found in 6 and absent in 1. The total result then of Haberern's 80 cases of primary osseous disease is 51 sequestra, and 29 soft caseating deposits.

I may now shortly describe what happens in a case of hip-joint disease when the primary seat of the trouble is in the bone as an example of what happens in tuberculous disease of any diarthrodial joint. When the primary deposit is in the usual situation, namely, at the lower part of the neck just outside the epiphysal cartilage, it spreads, on the one hand, towards the surface, and on the other towards the epiphysal cartilage. When the deposit reaches the cavity of the joint the whole surface of the synovial membrane becomes affected. The new tissue then spreads from the point of reflection of the synovial membrane over the articular cartilage, destroying it, and afterwards attacking the surface of the bone, producing caries, and the affection of the cartilage begins not only from the sides, but also from the points of attachment of the ligamentum teres.

As I have said, when the deposit is in the above situation it not only extends into the joint but also towards the epiphysal cartilage, which gradually becomes destroyed, at first at the lower part, and subsequently, it may be, throughout its whole length; in the latter case the head or its remains may be completely detached from the neck of the femur. When the deposit is situated further out in the substance of the neck or in the trochanter, it may not open into the joint at all but outside the capsule, and thus lead to the formation of extra-articular abscesses; in these cases, however, the synovial membrane is very apt to become involved during the progress of the disease.

The disappearance of the head and neck of the femur and portions of the acetabulum is partly due to the destruction of the bone by the tuberculous tissue, but chiefly to the rarefying osteitis which accompanies the disease, and which is generally very extensive; and this absorption of the bone may go on rapidly, and lead to shortening and bending of the neck of the femur and to enlargement of the acetabular cavity. This absorption is to a great extent brought about by pressure on the parts softened by the inflammation, this pressure being a very potent factor in keeping up the rarefying osteitis, and in causing the destruction of the bone. The pressure is not necessarily the result of standing, for even in bed, and with retentive apparatus, such as Thomas's splint, the tonic contraction of the muscles around the joint keeps the upper part of the head of the femur constantly in contact with and exercising pressure on the upper and back part of the acetabulum. As a result, the head of the bone gradually disappears, more especially at the upper and back part, where it becomes flattened, while the opposed part of the acetabulum becomes absorbed, new bone, though often only in small amount, being constantly formed from the periosteum around, and thus maintaining a buttress. This enlargement or "wandering" of the acetabulum, as it is termed in Germany, often goes on to a great extent, and marked shortening and apparent dislocation on to the dorsum ilii may result from the two processes. In fact, as is of course well known, this is by far the most common cause of shortening in hip-joint disease, true dislocation being rare.

True dislocation usually occurs as the result of some sudden movement which causes the shortened head and neck of the bone to slip out of the enlarged acetabulum; but it may some-

times occur even where the articular surfaces have not been much affected. Under such circumstances, however, there is usually marked synovial disease, and the ligamentum teres has become softened and converted into a tuberculous mass, which may fill up the cavity of the acetabulum. A partial dislocation of the head of the bone is more common, and is often associated with destruction of the margin of the acetabulum without the formation of an efficient buttress, or with destruction of the ligamentum teres without complete softening of the capsule. In this case the centre of the head is apt to be caught on the edge of the acetabulum, and a groove may be formed in it at the point of pressure.

While the enlargement of the acetabulum and the absorption of the head of the femur are going on, caseation of the tuberculous tissue is taking place, and the joint cavity generally contains a quantity of caseous material derived from the surface of the synovial membrane and bone. About this time, also, chronic abscesses form around the joint either inside or outside the pelvis, and the frequency of chronic abscess in hip-joint disease depends on the treatment, the general condition of the patient, and various other more or less unknown factors.

Without going further into the pathology of hip-joint disease, these few remarks will serve to illustrate the various parts played by the tuberculous disease, the osteitis, the pressure, etc., in the production of the deformities, and the other results of tuberculous disease of joints; and, therefore, I need not discuss the matter with regard to the other joints. The primary cause of the whole trouble is the tuberculous disease, but the main changes which occur are brought about by the chronic inflammation which is set up by the tuberculous growth, and which is often very extensive.

KNEE-JOINT.

The knee-joint is, after the spine, the most frequent seat of tuberculous disease of bones and joints, and young adults are the most liable to attack. In this joint there is also a larger proportion of cases of primary synovial disease than in the hip, the proportion varying, however, according to the age of the patients. The following are the results of Willemer's statistical observations as to the primary seat of the disease at different ages. Below 10 years of age, 39 per cent. were primarily synovial, and 61 per cent. primarily osseous; between 10 and 20, 49 per cent. were synovial and 51 per cent. osseous; above 20 years of age, 33 per cent. were primarily synovial and 65 per cent. primarily osseous. These numbers bring out the most important fact that during the time when this disease is most common (between 10 and 20 years of age), primary synovial and primary osseous disease are practically equal; while as age advances, primary synovial disease passes more and more into the background; and this, perhaps, explains to some extent the greater obstinacy of these affections in old people, more especially as in them of the two forms of osseous deposits sequestra are much the most common.

The following table gives the facts in greater detail:

	1 to 10.	10 to 20.	Above 20.
Sequestra	19.4 per cent.	19 per cent.	49 per cent.
Caseous bone deposits	41.6 "	32 "	16 "
Pure synovial	38.8 "	49 "	33 "

König also states that, in his experience, primary osseous and primary synovial disease are about equally frequent in youth, but in old people there are three times as many osseous cases as synovial. In 114 museum specimens he found that 69 were primarily osseous, 33 synovial, and 12 doubtful.

In 43 cases, of which I have made microscopical sections, I found 16 certainly synovial, 5 very probably synovial, 2 doubtful, and 20 osseous. Of the osseous deposits, in 2 cases there were more than one, in the remainder the deposit was single, and of these 11 were soft caseating deposits and 7 sequestra. My own opinion as to the relative frequency of the two forms is very much the same as that of Willemer and König, except that, in my experience, pure synovial disease is the most common form in youth. In the cases from which the sections referred to above were made, those where primary osseous disease was present were mainly adults.

The situation of these deposits varies considerably, but, in contrast to the upper end of the femur, they occur, at the lower end, by far most frequently in the epiphysis itself. In

none of the specimens of disease, either in the femur or the tibia, of which I have made sections, have I found a deposit beyond the epiphysal line, but I have seen two or three bottle specimens showing this, and König states that it sometimes occurs in children, especially in the form of soft deposits.

As to the parts most commonly affected, these deposits occur generally, as in the case of other bones, at the most exposed parts, and also in the neighbourhood of the points of attachment of tendons or ligaments. In the knee-joint the lower end of the femur, more especially the internal condyle, is most usually primarily affected, then the head of the tibia and, much more rarely, the patella. It is not at all uncommon for the primary osseous deposit, especially if soft, to be quite small and situated immediately beneath the articular cartilage, which it destroys; and in these cases the deposits are often multiple. The more deeply-placed deposits may also make their way into the joint, but they may, especially in the tibia, when extra-epiphysal, and also in the femur, when situated towards the posterior and upper part of the condyles, form a communication with the surface outside the capsule, and lead to the production of extra-articular abscesses. It is in this joint also that Kocher thinks that he has observed primary disease of fibro-cartilage, and that the rare forms of disease, such as localised synovial growths, hydrops tuberculosus, etc., most frequently occur.

In my lectures last year I referred so often to the knee-joint that it would be merely repetition to go further into the matter. Here, as in the hip, the main destruction is due to the inflammation which accompanies the tuberculous growth, and also to pressure. I shall now show a few specimens to illustrate the ordinary seats and extent of these deposits in the bones.

ANKLE AND TARSUS.

In the case of the foot the disease occurs most often in those parts which transmit the weight of the body to the ground, namely, the ankle-joint, the os calcis, the head of the astragalus and the proximal end of the first metatarsal bone.

As regards the relative frequency of primary synovial and primary osseous disease in the case of the ankle-joint, Münch states that in 28 cases where this joint was alone affected the disease was primarily synovial in 23, affected the tibia in the first instance in 1, and the astragalus in 4. Erasmus, on the other hand, found in 11 cases that only 2 were primarily synovial, in 3 sequestra were present, and in 6 there were caseous deposits in the bone (tibia alone in 2, astragalus alone in 2, astragalus and scaphoid in 1, and still more extensive in 1). My own impression, from my own experience and from various statistics which I need not go into, is that in the ankle-joint primary synovial disease is decidedly more common than primary osseous disease, and that the latter form begins most frequently in the astragalus, and next most frequently in the upper part of the malleoli. In some cases the deposit in the tibia is extra-epiphysal.

As regards the frequency with which the various tarsal bones are the primary seats of disease, statements differ very much, and it is by no means easy in an advanced case to tell where the disease commenced, for generally several bones show destructive changes. Czerny found in 52 cases that the astragalus was affected 15 times, the os calcis 13, the cuboid 16, and the scaphoid and cuneiforms 8 times; but, as before said, more than one bone was usually affected, and it was not always certain in which the disease had commenced, or whether more than one bone may not have been attacked at the same time.

I need not mention a number of other statements which are more or less contradictory, but we may take it that the os calcis is most frequently attacked, and next to it the proximal end of the first metatarsal bone; the cuboid probably comes next in order, then the astragalus, and the scaphoid and cuneiforms last. In the os calcis soft caseating deposits are more frequent than sequestra, and as a rule the projection of the heel escapes, though not invariably. Where there is disease of one of the tarsal bones the others are very apt to become affected with rarefying osteitis, and in some sections which I have made where the tuberculous disease was limited to one part of the tarsus I found the other bones so softened that they were merely shells of osseous tissue. In the tarsal

bones also we often find, instead of a limited osseous deposit, a diffuse tuberculous osteomyelitis involving the whole bone.

SHOULDER-JOINT.

Disease of the shoulder-joint is almost entirely a disease of adults, though it is sometimes observed in children. It is most often primarily osseous, and caries sicca is not uncommon. The disease commences perhaps most frequently in the great tuberosity of the humerus, and next in the neck of the scapula.

ELBOW-JOINT.

Disease of this joint is essentially an affection of young adults, and begins much more frequently in the bone than in the synovial membrane. Of the bones, the olecranon is the favourite seat, then the lower end of the humerus; the head of the radius only rarely. To mention some statistics: König found in 62 cases operated on, that the disease was purely synovial in 10, and osseous in 42; of these 42 cases the ulna, more especially the olecranon, was the primary seat in 22, the humerus in 17, the humerus and radius together in 2, and the radius in 1. Middeldorpf found in 137 cases that the disease was primarily synovial in 30, and osseous in 107. Of the bones, the ulna, chiefly the olecranon process, was attacked primarily in 49, the humerus in 33, the external condyle in 12, the internal condyle in 4, the humerus and ulna together in 18, the radius in 3, the humerus, radius and ulna in 2, and the radius and ulna in 2. Primary synovial disease was more frequent below 14 years of age than afterwards; the proportion between synovial and bone disease in childhood being as 29.5 to 70.5.

WRIST-JOINT AND CARPUS.

Disease of the wrist-joint is, I think, often primarily synovial; but it is most difficult to determine this point on account of the number and small size of the bones. Primary osseous deposits occur in the lower end of the radius, and also—and perhaps most often—in the proximal ends of the metacarpal bones, especially of the second and third metacarpal bones. In the specimens which I have myself examined I have not met with primary deposits in the carpal bones themselves, but I show here a specimen lent me by Dr. Thomson, in which there is primary disease of the trapezium.

Of other bones I may mention the following:—

RIBS.

Tuberculous disease of the ribs is mainly a disease of adults, and is, perhaps, most frequently associated with pulmonary phthisis or tuberculous pleurisy, although it frequently occurs independently of these affections; or it may be secondary to tuberculous axillary glands or to chronic abscess associated with spinal disease, and pointing in the side. The disease commences either as a tuberculous periostitis or a tuberculous osteomyelitis, most frequently as a periostitis. Where the seat of the disease is in the periosteum it affects the surface of the bone, leading to tuberculous caries, and most frequently it commences on the deeper surface. The surface of the bone thus comes to have a worm-eaten appearance, and this superficial erosion of the bone steadily progresses till a more or less marked defect is formed; indeed, such a bone not uncommonly fractures. At times, and especially in children, the part affected may be the perichondrium over the costal cartilages, and the result may be extensive necrosis of the cartilage. Wherever it begins, the carious process tends to spread along the same rib, or it may extend from one rib to another, or a number of ribs may become affected simultaneously or in succession. The rib may be denuded of periosteum, either in its entire circumference or only on one side, and the disease is almost always associated with abscess. These abscesses may spread towards the skin or towards the pleura, or they may pass along between the muscles and point further in front or behind, or, if the posterior end of the rib is the part affected, they may extend into the loin, or even form typical psoas abscesses. Much more rarely the disease commences in the interior of the bone and causes enlargement of it, just as in strumous dactylitis.

STERNUM, CLAVICLE, AND SCAPULA.

The sternum is not infrequently the seat of tuberculous

disease, and as in other bones it may commence as a periostitis or as an osteomyelitis. Superficial caries of the sternum is often very extensive, especially on the posterior surface, because the abscess formed in connection with the diseased part spreads upwards and downwards behind the bone for a considerable distance before it makes its way forwards between the ribs or upwards into the neck, and it infects the periosteum and the surface of the bone along its course. Deposits in the substance of the bone are not uncommon, and in 2 cases which I had not long ago, I found in one a caseous deposit and in the other complete necrosis of the lower segment of the bone. In the specimen which I show, from a child, where ossification was still incomplete, there is a defect in one of the cartilages, the result of the tuberculous process.

The clavicle is very rarely the seat of tuberculous disease, but it may occur, especially towards its outer end. The sterno-clavicular articulation is also occasionally affected.

The scapula also, apart from the neck and glenoid cavity, is very rarely the seat of tuberculous disease, and then usually as a part of a multiple bone tuberculosis. The part affected is generally the acromion process, and the disease spreads more readily towards the clavicle than towards the spine of the scapula.

FLAT BONES OF THE SKULL.

Tuberculous caries and necrosis of the mastoid process is, of course, a well known and common affection, but tuberculosis of the flat bones of the skull is very rare, and only a few cases have been placed on record. This disease affects young adults, and generally commences with dull pain in the head and pain on pressure over the affected part. These symptoms are presently followed by the formation of a fluctuating or semifluctuating swelling—in fact, a chronic abscess; in some cases, however, the first symptoms after the pain are those of pressure on the brain, due to the formation of a collection of pus between the dura mater and the skull. When the abscess is external, it bursts after a time or is opened, and then, on probing the wound, the bone is felt to be bare, soft, and breaking down under the probe, and usually one or more small necrosed fragments are present.

The bone most commonly affected is the frontal, especially in the neighbourhood of the orbital margin and the external angular process; sometimes, however, the parietal, and more rarely the occipital, bones are the seat of the disease. As a rule, the affection only affects one part of the bone at first, but it not uncommonly appears afterwards in other parts of the same bone or in other bones. The disease apparently more often commences in the diploë than in the periosteum. In the diploë we find the usual two forms, namely, soft caseating areas or one or more sequestra; the latter are most common. These sequestra are generally small, about the size of a pea or bean, but they may be more extensive, and in one or two cases they have been as large as a five-shilling piece; they generally involve the whole thickness of the skull, and in Volkmann's cases the inner table was more extensively necrosed than the outer.

As a rule, tuberculous disease of the flat bones of the skull only occurs in the course of very severe tuberculous bone disease; it may be the first affection, but generally it only commences after other bones have become involved. Thus in a case which I have seen lately, there was previously disease of the spine, disease of a rib, and disease of the left elbow-joint, with abscess formation in each instance, and the upper part of the sternum has lately become affected. The occipital bone was the part involved, and there was a considerable fluctuating swelling over the region of the external occipital protuberance. In one case mentioned by Israel, the disease followed a compound fracture of the skull, and there was no previous tuberculous disease elsewhere, so that it was in all probability a case of infection of the wound from without.

BONES OF THE FACE.

Tuberculous disease is more frequent in the bones of the face, and the most common seats are the lower margin of the orbit or the malar bone, and also, though rarely, the lower jaw. In the upper jaw the disease usually commences in the periosteum or in the soft tissues over the bone, affecting it secondarily, but it is not usually extensive; it generally leads

to marked ectropion. In some cases of ozæna the bones of the nose are affected, either primarily or secondarily to disease of the mucous membrane. Where sequestra are found, we generally have to do with primary bone disease.

VERTEBRÆ.

The most common seat of tuberculous bone disease, especially in children, is the vertebræ. The favourite seat of disease is the dorsal vertebræ, chiefly the middle and lower ones, then the upper lumbar, and then the cervical, especially the upper cervical. The greater frequency of dorsal disease is generally attributed to the greater number of the dorsal vertebræ, but apparently independently of the number of the bones the disease seems more often to attack this part of the spine. As in other bones, the disease commences on the surface as a tuberculous periostitis, or in the substance of the bone. In the latter situation we have the usual two forms, namely, circumscribed soft deposits and sequestra; in rarer cases the process may present the form of a more diffuse tuberculous osteomyelitis. The deposits in the interior of the bone usually begin close to the intervertebral cartilages, and rarely affect more than one or two vertebræ. They may make their way outwards in front or behind, generally in front, and then spread in the periosteum, leading to superficial caries. Whether the latter process commences in the periosteum or occurs secondarily to a deposit in the interior, it spreads along the surface, and generally extends over a considerable number of vertebræ. When it reaches the intervertebral cartilages, it spreads inwards in the bone immediately above and below them, and destroys them. This superficial form occurs more especially in adults, and is naturally most often associated with abscesses, while if it alone is present, there may be no curvature, or, in the first instance, only a gradual bend due simply to the loss of a number of intervertebral cartilages. On the other hand, the deposits in the interior of the bones are less frequently associated with abscesses, occur chiefly in children, and are accompanied by acute curvature and the other displacements which are sometimes present. In some rare cases the disease begins in the transverse or spinous processes in the form usually of tuberculous periostitis.

I may, in conclusion, mention the sacroiliac synchondrosis. Here the disease begins, either in the substance of the adjacent bones, the sacrum or the ilium, as a deposit which spreads towards the fibrocartilage, or, on the surface, as a periostitis, and, in the latter case, it is often an extension from the lower lumbar vertebræ. It apparently never begins in the fibrocartilage itself, but, as in the case of the intervertebral cartilages, the disease extends from the surface or from a deposit in the adjacent bones, and thus destroys the cartilage secondarily.

In all that I have previously said I have assumed that the term "tuberculous" disease of bones and joints was synonymous with the older term "strumous" disease, and though at the present time few will dispute this assumption, nevertheless I may mention the chief reasons for regarding strumous joint disease as being in reality tuberculous.

In the first place, many cases are now on record where wounds have become accidentally infected with tuberculosis, and where, subsequently, various diseases known as "strumous" affections have developed. A large number of these cases was mentioned by Mr. Barker in his lectures in this place, and therefore I need not repeat them, but I may call attention to one or two where bone and joint disease developed after the injury. Verneuil mentions the case of a student who injured the fold of the nail of his right ring finger at a *post-mortem* examination with the result that a *post-mortem* wart developed. This was treated in various ways without permanent improvement, and, after three years' treatment, there was still a tuberculous ulcer on the finger and a tuberculous abscess on the back of the hand. This abscess was opened and the ring finger was amputated, but chronic abscesses formed from time to time, and the patient ultimately died, six years after the injury, of spinal meningitis, due to suppurative in connection with tuberculous disease of the vertebræ.

Czerny mentions two cases where skin-grafting was employed in large ulcers, the skin being taken from limbs just amputated on account of tuberculous bone disease, and these

patients afterwards became subjects of tuberculous disease. In the one case the surface of the wound, which extended from the foot to above the knee, became covered with croupous unhealthy membrane, and the granulations became weak and œdematous. After some time a communication formed with the knee-joint. This sinus closed and opened again several times, and the patient died of phthisis fourteen months later, but there were no definite signs of disease of the knee-joint. In the other case the sore was over the thorax, and, after a time, the patient developed spinal disease with curvature and psoas abscess.

In Middeldorp's case the patient, a male aged 16, healthy and with no hereditary tendency to phthisis, received a penetrating wound of his knee-joint, to which he applied his handkerchief, and which healed in eight days. Fourteen days after the accident swelling of the joint was noticed with great pain on movement. During the following four weeks he suffered great pain, and had starting of the limb at night, etc., and his condition six weeks after the accident was that there was a scar below the patella, great thickening of the synovial membrane, and slight dulness at the apex of the right lung. Excision was performed, and the synovial membrane was found to be greatly thickened, but there was no disease of the bone. Tubercle bacilli were found in the synovial membrane. Middeldorp assumes this to be a case of inoculation, either from the axe or the handkerchief, chiefly because the patient's previous health was good; because the course was rapid, and because the time which elapsed between the injury and the commencement of the symptoms—fourteen days—is about the usual period of incubation.

Pfeiffer's case was quoted by Mr. Barker. It was that of a healthy veterinary surgeon, with a good family history, who, while dissecting a tuberculous cow, punctured the phalangeal joint of his left thumb. The wound soon healed, but induration of the scar took place, and later the whole joint became swollen and presented the typical appearance of a scrofulous synovitis, but without the formation of sinuses. Some months later the patient began to show signs of pulmonary phthisis, which rapidly increased, and he died of this disease a year and a half after the injury. The thumb, which was much swollen, but with unbroken skin, was removed for special examination. The joint on being laid open showed all the destructive changes of scrofula, both in the bones and synovial membrane; and in the latter, as well as in the broken down material which filled the intervals between the bones, an unusually large number of tubercle bacilli was present. The microscopical appearance of the diseased tissues was also typically tuberculous.

Barker has also published a case of joint-disease secondary to a *post-mortem* wart on the hand. His case was that of an assistant in the *post-mortem* room, aged 54, with good family history, who first contracted these warty growths ten to fourteen years previously, and at that time they healed. Seven or eight years before the date of admission he acquired another wart, which, however, disappeared under treatment, but had previously extended to the carpo-metacarpal joints. This was followed by tuberculous disease of the carpus, for which excision was performed.

A second proof that these strumous diseases are truly tuberculous is afforded by the microscopical structure of the tissues affected. In all these affections, tubercles and tuberculous tissue are constantly present in the thickened synovial membrane, the osseous deposits, etc., and present all the characteristics described in my lectures last year, in which I went so fully into this matter that I need not refer to it further. The results which I have obtained are similar to those of other observers.

The tuberculous nature of these diseases of bones and joints is further and definitely shown by the presence of the tubercle bacillus. As is now well known, tubercle bacilli are never found except in connection with tuberculous tissues; and when we bear in mind the experimental evidence and the rôle which this organism plays in the production of tubercle when inoculated on animals, we must assume that whenever we find tubercle bacilli in a morbid tissue, the disease with which we have to do is tuberculosis. Search has accordingly been made for these bacilli in the diseased tissues and in the caseous material or pus, with the following results:

Koch, in his first work on tuberculosis, stated that he had

found tubercle bacilli in small numbers in four cases of strumous disease of joints, in three cases of strumous glands, and in lupus. Schuchardt and Krause were the first to make an elaborate investigation on this subject, and they carefully examined 40 cases of surgical tuberculosis in patients of various ages with and without hereditary taint, the diseases to which they directed their attention affecting bones, joints, sheaths of tendons, skin (including lupus), walls of tuberculous abscesses, lymphatic glands, tuberculosis of tongue, testicle, uterus, and Fallopian tubes. Tubercle bacilli were found in all these parts, but in the great majority of instances they were few in number and only found after a long search. These authors thought that the small number of the organisms was due to the fact that these diseases are very chronic, and they supposed that the bacilli are most numerous in the early stages, although, as a matter of fact, they had no absolute evidence in support of this view. These observations have been repeated by several other observers with varying results. Thus Bouilly always succeeded in finding bacilli, though only after a long search. Mögling examined in all 53 specimens, of which 28 were from joints or bones; and he also obtained positive results, though the bacilli were, as a rule, present only in small numbers, nor were they specially limited to the giant cells, as had been asserted by earlier observers. Kanzler confirmed these statements. Schlegtendal, employing Ehrlich's method, examined the contents of 23 abscesses connected with bones and joints, and obtained 8 positive and 15 negative results, but he did not examine the walls of the abscesses. In all, including abscesses and sinuses unconnected with bone, 17 positive results were obtained with the pus of 40 unopened abscesses, and 9 with the discharge of 60 fistulæ or ulcers.

Müller examined from 30 to 35 cases of tuberculous disease of bones and joints, the specimens being chiefly obtained by excision, and he confirmed Schuchardt and Krause's statement, that with patience it is possible in most cases to find bacilli; in several cases, however, where recovery was taking place he looked for them in vain. His investigations do not add any support to the view that the bacilli are most numerous in the early stage of the disease, but he adds that in many preparations, whether bacilli were present or not, there were peculiar bodies, like drops of oil, which retained the red stain, and which he looks on as probably remnants of bacilli.

I have on repeated occasions examined the bones, synovial membrane, and pus from strumous joints, for tubercle bacilli, but as I have not always kept notes of the cases I cannot give the precise figures. The general result of my examinations has been that after sufficiently careful and prolonged search bacilli could always be found, but that in most cases they were extremely few in number. That the bacilli are present even when difficult to demonstrate by means of the microscope is evident from cultivation experiments, and from the results of inoculation of animals, but it is not easy to explain their apparent small numbers, and various theories have been advanced. As I have already mentioned, some authors suppose that the bacilli are most numerous at the commencement of the disease, and subsequently decrease in numbers. According to others they rapidly pass into the spore stage, and are then no longer recognisable by means of the microscope. My own belief is that we do not as yet possess a method by which we can stain all these bacilli at all stages of growth. I found very early in working with the tubercle bacillus that if we took sections in which large numbers of bacilli were present, and stained them in a simple watery solution of fuchsin, without any aniline oil, carbolic acid, or other similar body, a considerable number took up the stain and a few retained it even after a short immersion in the dilute nitric acid. Thus it was evident that the staining reactions of the bacilli differ even in the same specimen, and this is I think due to differences in the age and stage of growth of the organisms. At a certain age or stage of growth the sheath is probably more easily penetrated by the stain than at another age, and this corresponds with what we know with regard to other organisms. As showing that the external conditions cause differences in the staining reactions, I may recall the fact that the bacilli in smegma stain like tubercle bacilli, but after being cultivated on the ordinary culture media they lose this reaction. Similarly various bacteria,

when grown on solid culture media covered with a layer of butter, show the same reaction as tubercle bacilli in retaining the primary stain in spite of washing in nitric acid.

In sections of tuberculous synovial membrane stained by Ehrlich's method (bacilli red, tissues blue) I have not uncommonly found that while a few red stained bacilli were present there were also some which were blue, but which nevertheless presented the same microscopical appearance as the tubercle bacilli, and bore the same relations to the giant and epithelioid cells, and I have no doubt whatever that these are in reality tubercle bacilli in a different stage of development. The first case where this idea occurred to me was that of an undoubted tuberculous ulcer of the tongue, in which I failed to find any red stained bacilli, but, on the contrary, considerable numbers of faintly stained blue organisms resembling tubercle bacilli both in situation and in microscopical characters. Since that time I have paid great attention to this matter, and have seldom failed, in well stained sections from tuberculous joints, to find blue stained bacilli often in larger numbers than those stained red. I believe, therefore, that the apparently small number of tubercle bacilli in these local tuberculosis is often mainly due to the fact that they are growing slowly and with difficulty, and that their staining reactions differ at different periods of their existence. We require further research as to the methods of staining before we can conclude because we fail to find them by the ordinary methods of staining that they are therefore either absent or in the spore stage.

In connection with this matter it is interesting to note that I have found the same difficulty in finding tubercle bacilli in the synovial membrane of animals in which I have set up typical tuberculous joint disease by the injection of pure cultivations of tubercle bacilli, although they were easily demonstrated in the tubercles in the internal organs.

To sum up, we may take it that only few bacilli can as a rule be demonstrated in tuberculous joints and abscesses, but that they can usually be found in cases where the disease is progressing if the search be sufficiently careful and prolonged; and further, that our present methods of staining do not permit us to draw conclusions as to the numbers present.

THE LUMLEIAN LECTURES ON STRUCTURAL DISEASES OF THE HEART CONSIDERED FROM THE POINT OF VIEW OF PROGNOSIS.

Delivered before the Royal College of Physicians of London.

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LECTURE III.—FATTY DEGENERATION.

No form of heart disease is regarded with so much apprehension as fatty degeneration. More than any other, it carries with it the danger of sudden death and the liability to angina pectoris, and, although happily it is not very common, it would be a most important acquisition to be able to make the diagnosis with certainty at an early period.

Its causation, which must be considered as it bears upon the prognosis, is in some cases clear, that is, when there is disease of the coronary arteries or obstruction of these vessels by any other means. The heart—perpetually at work—cannot afford to be mulcted of its full supply of blood. When, from any cause, this is defective the wear and tear of the muscular fibres, which must go on, is not repaired and their structure breaks down. Whether the *débris* actually forms the fatty granules and globules which are found within the sarcolemma or the fatty particles are substituted for the atrophied sarcolemmal elements is not, perhaps, a settled question. The important point is that the primary change is atrophy of the muscle substance, the invasion of the fibres by fatty matter being secondary to this and consequent upon it.

Disease of the coronary arteries being thus a cause of fatty degeneration of the heart, the existence of conditions which