without the itching and the sensations of "pins and needles." House dust will bring on an attack, bedroom dust and the dust from shaking a bed being most potent. The dust of the street, curiously enough, does not affect her; indeed, she often experiences relief during a paroxysm from going out of doors. Flowers do not bring on the attacks, which cannot be due to hay, for she resides in a large city; they occur at all times of the year. Sunlight will not excite the attack, although she complains that it hurts her eyes. She obtains some relief from taking food, hot tea, or port wine. Her mother has been a sneezer all her life.

A middle-aged man, an ironmonger, has suffered from paroxysmal coryza and asthma for two years, the attacks being induced only by the dust of his shop. Other kinds of dust, for example that of a road, fail to affect him, and flowers, grasses, and bright sunlight are innocuous. The case is peculiar in this respect, that whilst coryza and asthma are excited only by the dust of his shop, he in certain localities suffers at night from simple asthma without coryza.

Sneezing may sometimes be induced by violent exercise. A patient, who has been a sneezer for twelve years, assures us that in his case this is the most powerful exciting cause, and he always suffers severely if he takes a long ride on his bicycle. The sneezing generally lasts half an hour or more, and is accompanied by profuse watery nasal discharge. When the exercise taken is unusually violent, the nose swells about the bridge, and the conjunctivæ become red and irritable. He does not suffer from itching of the nose or any part of the face. The attacks are never excited by dust, and he is not affected in any way by smoke, hay, or the smell of flowers. He has occasionally had an attack in the middle of the night, for which he can assign no cause. These night attacks, however, have ceased since he has worn a nightcap. Two years ago he became the subject of peptic asthma, and more recently caught cold, which brought on an attack of bronchitic asthma. The asthmatic attacks usually commence about two or three o'clock in the morning, and terminate with a sharp paroxysm of sneezing. His father was asthmatic, but has outgrown it.

Food is sometimes assigned as the exciting cause of attacks of sneezing. A nervous man subject to attacks of neuralgia stated that for nearly two years he had suffered from sneezing after meals, and especially after breakfast and dinner. The occurrence of these attacks was favoured by excitement, nervous fatigue, or brain work. He often wakes up with a migrainous headache over the left brow or at the back of the head, and then immediately after breakfast sneezes violently twenty or thirty times, the attack being accompanied by cough and expectoration, and running at the nose and eyes. He has never been able to discover any other cause for the attacks except food. It is probable that in this case the affection is central in origin. We assume that an impression conveyed from the stomach through the vagus and reaching its centre would, through diminished resistance in this part of the central nervous system, spread thence to that part of the fifth nucleus in connection with the nerves proceeding from the mucous membrane of the nose, inducing in this part of the nervous centre those molecular changes which impress on the sensorium the sensation of tingling or pricking, and this condition of the nervous centre of the fifth excites violent sneezing.

From these cases it will be seen that the exciting causes of attacks of sneezing are various, the chief being pollen, the emanations from various animals, and bright sunlight. In some instances it is difficult or impossible to discover any exciting cause, as is often the case in the allied affections—asthma, neuralgia, and migraine. In these cases the mucous membranes may be perfectly healthy, or there may be slight chronic catarrh of the nose.

The following case illustrates the power of this nasal irritation to intensify the attacks: The patient, a gentleman aged 45, has been subject to neuralgia for many years. He has had attacks of persistent sneezing for three months. They may occur at any time of the day, but are usually worse after dinner. He has constant tingling in the left nostril posteriorly, and in the region of the septum. At times this pain becomes much worse, and radiates over a large area, reaching the ala of the left nostril. This "sharp pang," as he terms it, excites the attacks of sneezing. There is a constant watery discharge, but this is intensified during the sneezing attacks. The discharge is worse from the nostril which itches. He is quite unable to discover any exciting cause, but is satisfied that it is not dust or pollen or bright light.

A lady, aged 70, has almost every night for years had attacks,

lasting from twenty minutes to an hour, beginning with itching behind the sternum, and leading to a severe paroxysmal cough, accompanied by profuse running from the eyes and nose without itching of the nostrils or eyes, and with only an occasional paroxysm of sneezing. This case is of interest from its affinity with asthma.

Asthma, as we know, often changes its character, and may be replaced by paroxysmal cough or dyspnoea. Many patients suffer from itching over the sternum, which precedes the attack. We know, too, that many diseases in their transmission from parent to child change their type; an epileptic parent, for example, begetting a neuralgic, migrainous, or rheumatic child, or several members of the family may have different neuroses. In other words, these same changes in the nervous system in transmission affect probably a different part of the central nervous system, and so induce a different set of symptoms. We know too that in the same individual one neurosis may replace another, and this interchange may occur not once but many times. In other cases two or more neuroses not only affect the same person, but the attacks may occur simultaneously, a fact well illustrated by the following case.

A little girl, aged 6, has had chronic Bright's disease for some years, but she is now nearly well, although a little cystitis remains. Every week, or sometimes oftener, she has attacks of running from the eyes, the lids becoming swollen, the upper especially, and the conjunctivæ suffused and bloodshot. The right eye is always more affected than the left, the difference being well marked. There is great intolerance of light, so that the room has to be darkened, and usually she keeps her eyes covered with a shade. The nose runs, but she seldom sneezes. The bowels invariably act at the onset of the attack, the motions being light in colour. She always vomits about half an hour after the commencement of the attack, and ejects a large quantity of bilious matter. The tongue is red and spotty, and frequently covered with circular patches like raw beef-steak. There is no shortness of breath, but the attack is followed by drowsiness. The only cause that can be discovered is excitement, but often enough the attacks come on when the patient has been kept quiet. It is thought that inattention to diet will intensify them and prolong their duration, but on this point the evidence is not clear.

THREE LECTURES ON TUBERCULAR JOINT-DISEASE AND ITS TREATMENT BY OPERATION.

Delivered at the Royal College of Surgeons of England, June, 1888.

By ARTHUR E. J. BARKER, F.R.C.S.,
Hunterian Professor of Surgery and Pathology at the Royal College of
Surgeons; Surgeon to University College Hospital; and Teacher of
Practical Surgery at University College.

LECTURE II.

IN the light of the researches and deductions briefly alluded to in my last lecture, we have now to consider the behaviour of tubercular disease in the joints. That this is identically the same affection as that known under the same name in the lungs and other organs, there can, as I have shown, be no manner of doubt; and that the presence of the bacillus tuberculosis is associated with analogous tissue changes in the joints to those found in the internal organs, is also, I think, beyond dispute. But why the structures entering into the composition of the articulations are so liable to be infected, as appears to be the case, is one aspect of the question which claims a short notice.

In the first place, it is almost certain that here we are dealing with a secondary infection in the vast majority of cases; in other words, that the organism introduced into the system elsewhere and present in the blood has found, in its wanderings, a home peculiarly fitted for its growth in the tissues of the joint. That direct infection of the latter may take place through a wound has been shown more than once, notably by such cases as those recorded by Pfeiffer and Middeldorpf; but this must be such an exceptional occurrence as hardly to need consideration.

In speaking of infection of the joints it will, of course, be understood that only the synovial structures and the cancellous tissue of the bones are referred to. In these alone does the dis-

case take its origin, however deeply it may ultimately involve the other components of the articulation. Studied in its earliest stages, articular tuberculosis is seen to consist in the deposit of the characteristic granulations either in the synovial tissues, or the medulla of the ends of the bones, or in both together. In these tubercles, made up of the typical lymphoid, epitheloid, and giant-cell elements; the bacilli are often scantily represented, and require care and patience for their demonstration. That the avascular cartilage, the highly-differentiated, compact bone-tissue, and the fibrous material of the ligaments and capsule are primarily exempt, is clear even from the most casual examination.

The reasons for this must be sought for in several directions. In the first place, adopting the view alluded to above that the disease is only a local expression of a general infection, and that the specific is circulating in the blood, it is only to be expected that the characteristic foci of hyperplasia produced by the organism should be most frequently, if not exclusively, found wherever vascularity is greatest. Or, to put it conversely, as the blood is the distributor of the organism throughout the body, those tissues with a small vascular supply ought to have the greatest immunity from infection. And this is just what we find everywhere in studying tuberculosis. But looking further into the matter we can, I think, trace the operation of other factors, for it is certain that tubercular disease does not commonly develop in *every* part to which the organism is carried by the blood. We have seen elsewhere how predisposition of individuals plays an important part in the spread of this disease. Given, then, an individual predisposed by hereditary debility to tuberculosis, we might expect tubercle to manifest itself *first* at those spots in the system where the vital energy was at its lowest from one cause or another. Setting aside for the present the question of traumatic or other lesions, are there any special reasons why joints should be so frequently selected by the organism as a point of attack? Undoubtedly there are. It is well known that the disease generally finds its most fertile soil among the very young, probably because, among other reasons, the vitality of the young cells is unequal to cope with the invading organism. And, if this be true, we should expect to find that, with the bacillus once in the blood, those tissues which are youngest, or, in other words, approach most nearly to the embryonic type, should be most liable to suffer from its attacks. Now, such embryonic tissue is abundant in childhood, and most so at those spots where growth and physiological activity are greatest. In adults such tissue has become scanty, although we may find its analogue in the cellular products of plastic exudations. But the medulla of the ends of growing bones and the synovial structures both abound in embryonic tissue hardly yet differentiated, and are in active growth. And that this tissue all over the body is peculiarly liable to inflammatory disease of every kind, experience, whether of purely traumatic conditions or infective influences, abundantly proves. This fact may be noticed, for instance, in the so-called general septic affections.

But the matter may be put in another light. It may be suggested that young growing tissues being necessarily very vascular, the physiological hyperemia requires but a slight stimulus to convert it into a pathological congestion. Be this as it may, it is important to note that throughout the body highly differentiated tissues—such, for instance, as muscle or tendon—are not liable to inflammatory changes in anything like the same degree as the areolar tissues or the soft vascular material forming the basis of the synovial fringes of joints. And in the case of bones, we may observe that all inflammatory changes, whether purely traumatic or infective—as, for instance, after measles and scarlet fever—have their starting point, not in the cartilage or the compact tissue, but in the growing material underlying the periosteum and between the epiphyses and diaphyses, or in the medulla itself. That great physiological activity predisposes in some way to inflammatory disease could not be more simply or better illustrated than by reference to the frequency of suppuration in the breast during lactation and the rarity of this condition at other periods. Now, the physiological activity in the neighbourhood of joints in children is, of course, very great. We find here the most rapid bone growth, and a correspondingly active development of the synovial membrane. And it is in these structures that inflammatory troubles start so readily in children. Moreover, after the structures in question have attained maturity, inflammatory disease (apart from injury) becomes rarer and rarer in them. If one were asked, then, to suggest the most potent factors in the predisposition of joints to tubercular disease, one would be inclined to say, in the first place, the inherent low vitality of the

youngest tissues; and, in the second, high physiological activity—unless, indeed, we regard these two factors as one and the same thing. But this would, I think, be an improper view to take, for there does seem to be a difference between low vitality due to the age of a tissue and that susceptibility to give way before opposing forces found in the conditions produced by great physiological unrest. In this very case of the joints, we find that, after maturity has been reached, and the bones, having attained their full size, have lost their epiphyseal and periosteal embryonic tissue, they cease to be a prey to primary tubercle, while the synovial membrane is *still* liable to the disease, its functional activity being called into play as much or more than ever under the increased stimulus of the vigorous adult movements of the articulation. It is extremely difficult—nay, almost impossible—to accurately determine the relative frequency of tubercular disease starting in the synovial membrane and that starting in bone, and, after carefully examining numerous tables compiled with a view to elucidate this point, I cannot say that they come even near definitively settling the matter. But one point, I think, may be accepted as almost certain, namely, that tubercular disease starts more frequently in the bone *alone* in childhood, and in the synovial structures alone in adult life. If this preponderance of primary synovial disease in

Fig. III.—Upper end of young femur, showing a focus of tubercular disease (a) at the usual starting point in the epiphysary line of growth (from a specimen in University College Museum).

the adult be a fact, as I think it is, it would be best explained by the cessation of physiological activity in the bones while it continued in the synovial tissues, the other factors in the production of the disease remaining unaltered.

From the above considerations it would appear that there are several kinds of predisposition to tubercular disease of joints. In the first place, a peculiar debility may be inherited from phthisical or otherwise unhealthy parents, rendering the tissues of the child generally less capable of repelling the attacks of the parasites than had it come of a robust stock. Next there is the general predisposition of early age, the tissues of the young having less resisting force than those of the mature. Thirdly, certain localities in the body appear to be particularly open to the attacks of the organism, owing probably to the hurried physiological changes involved in rapid growth which are going on in them—changes which are associated with the presence of abundance of almost embryonic tissue and great vascularity.

In support of this view let me point to what is usually, if not invariably, found when the ends of the long bones, for instance,

are examined in the *earliest* stages of scrofulous disease. Take the upper end of the femur as represented in these drawings from specimens in our museum at University College (Figs. III and IV), or the lower end of the femur and upper end of the tibia, which I have copied from Koenig's plates (Figs. V, VI, VII). In every one of these specimens the initial lesion is found

Fig. I.—Sk., sclerotic; C.M., ciliary muscle; I., iris; C., cornea; T.F., tubercular foreign body (the black dots represent bacilli); Gr.K., granulation capsule around latter packed with bacilli; N, new scar tissue in corneal wound with bacilli; Beg. T., beginning of tubercular hyperplasia around bacilli.

as a focus of hyperplasia, with caseation at the lines of most active growth between the epiphyses and diaphyses. And I could produce specimens showing that this is the rule for all the long bones and most of the short ones.

Fig. IV.—Section of the upper end of a young femur showing centres (a a) of tubercular disease at either side of the epiphyseal line of cartilage. The surfaces of the bone have not yet been reached.

The bearing of this fact upon the question of early conservative operations on the ends of bones, *versus* later and more complete excisions of entire joints, is obvious, and needs no further emphasis here. Its practical importance I hope to refer to again later on.

Finally, there is the predisposition of external injury, using the term in its widest sense. In the case of the joints, injury may

render their tissues more open to the attacks of the bacillus tuberculosus circulating in the blood, in several ways acting singly or together. In the first place the violence may cause more or less active inflammation, with exudation of plastic material into the tissues around. Such exudation material resembles embryonic connective tissue, and seems to have very little power to resist the attacks of the organisms; in other words, it offers a favourable soil for its growth. This we have seen in the case of inoculation of the rabbit's eye with tubercle by Baumgarten (Fig. I), where the bacilli spread most rapidly into the granulation capsule (Gr. K) and along the cicatricial tissue of the corneal wound (N) than in any other direction.

Further, the increased blood-flow to an inflamed part would also, *ceteris paribus*, involve a greater supply of bacilli to it than if the vascularity were normal. Again, without any active inflammation, or, following upon it, vascular atony may result from violence to a joint, and passive congestion of its tissues be the result, as is so often seen clinically. In this condition not only is the general nutrition of the part damaged, but the slowing of the blood-stream in the smaller vessels, amounting often almost to stasis, offers a better opportunity for the deposit of the bacillus in the parts around than is afforded with a normal circulation. And here, too, the greater amount of blood entering the congested area would bring a larger army of organisms to the attack. Finally, injury to a joint will often produce more or less extravasation of blood into its tissues, which remains for a time unabsorbed. With this blood the bacilli, too, escape from the vessels, and in

Fig. V.—Lower end of young femur, showing a focus of tubercular disease (a) close to the epiphyseal line, and bursting on posterior aspect of bone outside the capsule (after Koenig).

their new position withdrawn from the current of the circulation, and in a state of rest they meet with the most favourable conditions for further growth, and soon form large colonies. This last-mentioned effect of injury is probably a most potent factor in the determination of the points at which tubercular disease shall start throughout the body, and will best explain its appearance in many unusual situations. Those who are not familiar with Schüller's experiments bearing upon this point will do well to give them their careful attention.

The parasitic nature of tubercular or scrofulous disease of joints has now, I hope, been sufficiently indicated, and its great power of extending locally and generally. In its modes of spreading by contiguous infection, through the lymphatics, and by entrance of its virus into veins, it offers, as we have seen, a close parallel to the modes of generalisation of the so-called malignant neoplasms. Indeed, there is much to justify our regarding tubercle itself in the light of a malignant growth, and our dealing with it accordingly. But that in spite of its capacity for wide dissemination it may remain for a long time localised in a joint, the rest of the system continuing unaffected, I need not undertake to prove; every clinical observer is thoroughly familiar with the fact. On the other hand, we must all have been impressed with the experience that in many cases after a long period of quiescence as a purely local affection, tuberculosis has rapidly become general. We must have noticed that this has usually followed upon some injury to a fully developed caseating focus, or the bursting of some caseous abscess, or, what is perhaps of greater importance for us as surgeons to remember, it has followed soon after a surgical operation upon a tubercularised part. From Wartmann's statistics, embracing the results of 837 resections, it would

appear that in at least 10 per cent. of the total number of deaths following operation, rapid, general, military tuberculosis supervened in such a way as to suggest strongly, if not to prove, that the surgical interference was the exciting cause of the generalisation of the disease. And I cannot help feeling, after a careful study of large masses of statistics, that if it were possible to analyse them more accurately, this percentage would be still higher.

This is a very grave consideration for the operating surgeon. But if, instead of closing our eyes to the fact, we set to work to determine the actual causal relation of operation to this general dissemination of tuberculosis, we shall in the future be able to eliminate one more risk in such cases, and shall escape the pain of seeing every now and then a patient relieved of his local disease only to succumb to rapid general tuberculosis set going by our operative interference. The explanation of this occasional generalisation of tuberculosis as the result of disturbance of a localised caseous form is to be found in what we have already considered. It will be remembered that the first effect of the introduction of a portion of tubercular tissue into the living rabbit's eye was the encapsuling of the same within a layer of granulation tissue. Now, beyond this latter (Fig. I, Gr. K.) the bacilli undoubtedly spread to some relatively small extent, as we have seen, but the fact remains that it is within this granulation capsule that they most rapidly multiply and accumulate, and that they appear to be imprisoned in a measure within it. In the same way, when inoculated in certain quantities in the human body, there is good reason to suppose that as a rule a similar capsule of granulation tissue is thrown out around the bacilli in sufficient quantity to limit their further extension, or at all events to prevent their

Fig. VI.—Section of young femur to show a focus of tubercular disease (a), starting at the line of epiphyseal growth, and eating its way into the growth secondarily (after Koenig).

escape into the body generally in greater quantity than can be dealt with by the eliminatory powers of the various organs. That they can be got rid of from the system by excretion has been proved beyond doubt, for they have been found in several of the secretions; and it is also probable that to a certain extent, when the dosage is small and the individual vigorous, they can be totally destroyed within the body before they find a suitable soil for their growth.

Now, as long as this limiting layer of plastic exudation remains undisturbed and unbroken, whether it still preserve the form of granulation tissue or have undergone that organisation into fibrous tissue often found around caseous foci in various parts of the body, we are justified in believing that a very considerable obstacle is offered to the dissemination of the organisms within it, and that the disease remains in many cases almost or altogether localised. But if in any way this barrier is dissolved by suppuration or broken through by violence, a means of escape for the bacilli is provided, and more or less generalisation of the disease takes place. The organism may be distributed over a wider local area, may be carried along the lymphatics to be arrested partially or completely in the glands, or may gain access to an eroded or torn vein, and thus be carried in overwhelming numbers into the general circulation, as shown by Weigert. We are all familiar with the rapid swelling of the neighbouring glands which often takes place when a scrofulous joint has received a fresh injury or has been over-exerted; and here, too, it is probably a question of the disturbance of a latent tubercular focus.

Again when a caseating centre, say in the knee or hip, has burst through the skin, and the resulting sinus has become inflamed, how often do we see the inguinal or pelvic lymphatic

glands enlarge and in many cases soften, whereas they had been little or not at all affected during the months or years the tubercular forms may have remained in an unbroken and inflamed state. This can best be explained either by the increased stimulus given to absorption, by the access of pyogenic organisms previously excluded by the unbroken skin, and the taking up of the bacilli tuberculosis together with the newcomers; or the occurrence of suppuration has resulted in destruction of the limiting layer of granulation or fibrous tissue which had hitherto shut off the organisms from the rest of the system. And after operation—say, an excision—if the resulting wound unhappily suppurates, we have often both of these factors working at once for the spread of the infection. There is the increased absorption from the lymphatics, and besides there is probably in many cases a taking-up of the specific virus through the radicles of the vein wounded by the operation. These may have run close to the foci of disease, both in the soft tissues and in the bones, in which latter, from their anatomical arrangement, they are peculiarly fitted to take up all kinds of fluid matter.

From all this there ought to be considerable risk of producing a general infection by operating on local joint-disease of a tubercular nature. It would be possible to invoke further aid from statistics in order to strengthen the conclusion that this is so;

Fig. VII.—Section of young tibia, showing tubercular disease starting at line of epiphyseal growth, and producing a sequestrum involving the joint secondarily (after Koenig).

but from lengthy and elaborate statistical statements I purposely abstain throughout these lectures, trusting rather that my audience will credit me with an earnest desire to give them fair deductions from the statistical evidence before me rather than weary them by a recital of the figures themselves. Some of these data may be found in such tables as those containing the experiences of Mr. Marsh and Mr. Croft in the *Clinical Society's Transactions*, and in the admirable monographs of Koenig, of Willemer and of Wartmann. But if such risks exist, we may, by a careful study of their causes and effects, learn to avoid them, or, at all events, reduce them to such an extent that they are far outweighed by the benefits of operation.

In the first place the improved powers of diagnosis at the present day bring the scrofulous diseases of joints under our notice at a much earlier stage than formerly, and consequently we have the option of treating them by operation or otherwise from the first. We are also able to determine with tolerable accuracy whether the articular affection is primary or only a local manifestation of a general condition.

How often joint tubercle is really a local affection it is difficult to prove by figures; but from Koenig's analysis of his own long series of cases, which is the most accurate guide that I know of, it would appear that in over 21 per cent. no evidence of any other tubercular affection could be found; and, as he remarks, this percentage will probably be found in the future to be much under the mark. We are speaking here of *palpable* evidence of infection elsewhere than in the joint only; for of course, in one sense, tubercular disease in the latter is always secondary—that is to say, the organisms have been imported into the tissues of

the articulation from some spot of primary inoculation. But there is ample evidence to show that, so introduced, it may localise itself in one part only of the body, such as a joint, and remain limited to that part for a long time.

Now by the mere fact of an early diagnosis one of the risks above alluded to may be reduced considerably, whether we operate or not. By attention to general hygiene in every way known to us the vitality of the tissues may be increased, and their power of resistance to the spread of the infection throughout the system be greatly enhanced. Again, by rest of the tuberculised joint, and by protecting it from external influences, whether of varying temperature or of violence, the tendency of the local infection to spread may be restrained. The mere staying off of suppuration by these measures will also tend largely in the same direction, as may be seen from any of the carefully-recorded series of cases referred to, but in none better than in those of Marsh, Croft, Willemer, and Wartmann.

The general ill-effects of suppuration upon the *ultimate* results of tubercular joint-disease cannot be better illustrated than by an allusion to Willemer's tables, in which the knee is specially referred to. In these the results are recorded after the lapse of several years, the shortest time being two and a half, the longest nine years since the reception of the patients into hospital.

KNEE TUBERCLE (WILLEMER).

	Non-suppurating, 68.	Suppurating, 102.
Resected	51.0 per cent.,	60.0 per cent.
Amputated primarily	0.0 "	16.0 "
Treated conservatively	49.0 "	24.0 "
Of the last group treated conservatively there were, after a lapse of years:		
Complete cures	54.0 per cent.,	34.0 per cent.
Incomplete cures	18.0 "	19.0 "
Ultimate cure by amputation	6.0 "	13.0 "
Deaths	22.0 "	34.0 "

In speaking of suppuration I do not mean that we should always aim at anticipating liquefaction of the tubercular material by operation. This softening is not of course suppuration, but is due to a fatty necrotic change in the infected tissues. When suppuration is referred to something quite different is meant, namely, that inflammatory exudation which sometimes is associated with caseation when a tubercular focus is subjected to injurious external influences.

It is most important to draw the clearest distinction between the liquefaction of caseation and true suppuration, not only as an abstract pathological axiom, but also for practical purposes. Of course the necrotic changes and fatty degeneration which take place in a caseating nodule are as different from the exudative and proliferative processes at an inflamed and excited spot as death is from life. But the matter has its practical bearing on treatment. If a surgeon adopts the view that no operation is proper until suppuration has taken place in the tissues of a joint, he will always operate in very advanced disease. Tubercular affections are not associated with true suppuration, except at what may be called an advanced stage; so that, if the surgeon waits until it is present, much valuable time will have been irrevocably lost. But if the rule is made to operate as soon as there is evidence of the commencement of caseation, the conditions of operation are totally different. We shall be interfering in such a case relatively early, and with all the consequent advantages. We must, therefore, in the future watch for and endeavour to recognise early the doughiness of commencing caseation rather than wait for the distinct fluctuation of suppuration.

Again, if the increased risk of generalisation of the tubercular infection associated with the access of pyogenic organisms through the formation of sinuses be recognised, we shall be more careful to step in early, and, before the latter have formed, will remove the whole of the locally infected tissues as thoroughly as possible, and secure union of the resulting wound by first intention.

Moreover, in undertaking any operation, we shall be careful not only to go wide of the disease, whether osseous or synovial, but also to do so with as little violence to the surrounding healthy tissues as may be possible. This last point is of the utmost importance; for, if we believe in the infective nature of the disease at all, we must believe in the possibility of re-infecting our own wound from the tubercular material we are engaged in extirpating; and this danger will be greatly enhanced if by vio-

lence in handling the tissues around we open up the small veins, or tear pockets from which the dangerous *débris* cannot be washed away so easily as from a clean-cut wound. Moreover, by rough handling during operation the likelihood of subsequent reaction and suppuration in the track of the wound is much increased, and the dangers of this in addition to the probability of general infection we have already seen. Finally, when we operate early before suppuration has taken place, we can ensure the rapid healing of the wound we have made. All subsequent disturbance of the freshly-injured joint can, in the case of such a clean, non-suppurating wound, be avoided by the use of permanent dressings and immovable apparatus. Vascular and lymphatic excitement will thus be speedily allayed, and with this the probability of the spread of the disease locally or generally from small quantities of the tubercular virus, perhaps left accidentally behind in the operation wound, be diminished. The sooner a wound is healed and the quieter it is kept for a long time after, the less likelihood will there be of a rekindling of the original process or the general dissemination of the virus from it. And not only this, but if suppuration is anticipated and prevented, we need have no fear as regards amyloid disease or exhaustion carrying off the patient. One has only to glance at any of the older lists of excisions to be impressed with the perils which lie in this direction, and to be convinced of how much might have been done to ward them off by forestalling suppuration by excision or getting rid of it by amputation.

I purposely abstain here from going into the question of the better prospect of a useful limb after an early excision than after extensive disease has necessitated free removal of bone. This may require consideration later on, but I am anxious now, in the first place, to emphasise the need there is of attending to the reduction of the mortality from tubercular disease of joints before we have anything to say as to the preservation of their functions. There is but little use of course in preserving to a patient the functions of his joint if the prospect of his being delivered from what may be called almost a malignant disease is not improved by our operation, still less if his chance of this is diminished. I need only remind you here that more than half of the total mortality after resections for tubercular disease is due to extension of the tubercular process, either locally or generally. Glance for a moment at Sack's analysis of 144 excisions of the knee with 25 deaths. In 13 of these the cause was tuberculosis. Or Mr. Croft's list of 45 excisions of the hip with 18 deaths, at least 6 of which were due to tuberculosis. Grosch's table of 120 cases of antiseptic excisions of the hip show the same thing. Here, with a mortality of 36.7 per cent., more than half the deaths were due to tubercular affections. These results have certainly not been due in every case to the steady advance of general tubercular disease which existed before the operation. And anyone who will carefully weigh the evidence which is now accumulating from all sides, and especially Weigert's researches on extension of the process through the veins, and Arnold's observations in the same field, can come to but one conclusion, namely, that the general affection has been set up in very many cases by extension from the local joint-disease, just as sarcoma and carcinoma become generalised from a primary source.

I have now briefly alluded to the chief risks which surround patients afflicted with tubercular joint-disease, and have hinted that one of them may be enhanced to a certain extent by operative interference, if undertaken without due caution. And we have seen in a measure the direction this caution against local re-inoculation of the disease should take. But there are other risks more especially connected with operation (though they may appear in the course of cases never submitted to the knife) to which attention must be directed for a moment; I allude of course to the septic infections of various kinds which may follow operation. In former years these risks were so imminent as to produce considerable hesitation about operating at all on a large scale in this class of cases. But, nowadays, with all the improvements of aseptic treatment, surgical infective diseases have become so rare that we are relieved of our chief anxiety in considering the propriety of interference by operation.

A comparison of any of the older statistics of the pre-antiseptic period with any of those of recent years will convince us of the stride that has been made in this direction. No better illustration could be given than Willemer's analysis of 195 cases of tubercular disease of the knee operated on in Koenig's clinic. Out of these only thirteen died as the direct effect of the operation, that is, of erysipelas, pneumonia, sepsis, tetanus, carbolic in-

toxication, and hæmorrhage—a mortality of only 13.6 per cent.

Now the vast improvement which has already taken place is but the first step in what is to come, and I venture to think that the time is not far distant when operations on tubercular joints will be performed with as little fear of accidental septic wound diseases as are our osteotomies and tenotomies, in which we do not expect even 1 per cent. of mortality from these causes. The only remaining risks then in connection with tubercular joint-disease will be on the one hand the acute infective tuberculosis connected with operation alluded to already, and the mortality from which at the present time may probably be estimated at about 10 per cent. of the deaths from all causes (Wartmann), and on the other, the chronic tubercular affections which arise in these cases independently of operation, and within the first few years after the latter, the death-rate from which is still higher. Recent statistics, however, especially those of Willemer, give us good ground for hope that here too a great improvement in the mortality may be effected by early operation and an intelligent recognition of the way to avoid reinoculation during the latter, so that on the whole the prospect for the operator is daily growing brighter in this region of surgery. At all events we now know two at least of our great enemies in this field, and we have also learned the tactics necessary to defeat them. And suppose for a moment we are able to wipe out completely the mortality from pyæmia, erysipelas, etc., due to operation, and also that from acute tubercular meningitis, etc., set up in all probability by the latter, we should see such a table, for instance, as that of Mr. Croft's hip incisions, altered marvellously for the better. We should see 39 per cent. of the total number of deaths due to the first set of causes, and 11 per cent. due to the second swept away with one stroke; in short, 50 per cent. of the total mortality would be done away with for this terrible class of affections. Moreover, this probably does not represent anything like the gain which would indirectly follow, and which will follow I believe firmly in the near future now that we are recognising the true nature of the risks to be combated.

Leaving this brief, and I am conscious necessarily imperfect, sketch of the nature of tubercular joint-disease to serve as an indication of the line of action we should pursue in dealing with it by operation, I pass on now to consider the methods which I venture to consider can most be relied on in effecting our object. And here let me say at once that I think in the case of most of the joints of the extremities the choice, when we can make a choice, should only lie, as far as operation is concerned, between *early* excision, partial or complete, and amputation. The practice of excising in advanced disease cannot be too strongly deprecated. After what has been said above regarding the dangers of producing a wider local infection and a general tubercular disease by imperfect interference with a local focus in a debilitated patient, and about the other risks bound up with late operation, this need not be further insisted on here. When tubercular disease is far advanced we shall find better ultimate results from the simple cleansing of sinuses and opening of abscesses than from excision, and better still from amputation. If we examine any long list of accurately recorded excisions we must be struck with the fact that it is the operations on late cases that have so fearfully swelled the mortality hitherto, and made them compare so much less favourably than we would wish with series of cases treated entirely without any severe operation. I do not think that the service which Mr. Marsh has done in emphasising this point by his tables recording the result of hip-joint disease treated without excision has been sufficiently appreciated.

But we cannot conceal from ourselves that operative interference with tubercular joint-disease without actual excision, that is, by the opening up of abscesses and the scraping out of sinuses, has also many dangers connected with it, and should be resorted to with the utmost caution for the reasons given above. Every surgeon of any experience must have regretted often having persisted in opening abscesses and scraping out sinuses in the hope of saving an extremity, only to see his patient succumb to general tuberculosis or septic infection where an amputation would have saved life. I cannot help feeling that conservative surgery has gone too far in this direction at the present day, and that with our newer views as to the true nature and tendencies of tubercular joint-disease we must aim at bringing about a reaction in favour of amputation well above the diseased area in many advanced cases. The direction which the conservative surgery of the future should take is to try to recognise the disease as early as possible, and, if it is distinctly on the increase in spite of the

best hygienic measures, to attack it by early and free operation, so that, on the one hand, only sound tissues are left behind, and, on the other, the resulting wound shall not be so severe as it would have to be later on, and may heal by first intention.

What, then, are we to consider as proper cases for early interference? It is quite plain that a considerable number of tubercular joint-diseases may run their course without any suppuration either to arrest of the local condition or to death from general tuberculosis. If we turn to Mr. Marsh's invaluable tables of 401 cases of hip-disease, for instance, treated *without* operation, we find that 124, or 31 per cent., did not suppurate; by which I suppose is meant that no caseous abscesses in and about the joint could be detected. Now, of these 69.3 per cent. were cured or convalesced, 20.2 were incomplete cases, and 10.5 died. This is in striking contrast to the results in suppurating cases not operated on given in the parallel column of the accompanying table.

HIP-DISEASE. (MARSH).

	Non-suppurating.	Suppurating.
Cures or Convalescents ...	69.3 per cent.	against 42.5 per cent.
Incomplete cures ...	20.2	" 24.3
Deaths ...	10.5	" 33.2

Taking the most hopeful view of the middle group, we may perhaps assume that about 89 per cent. of these non-suppurating cases recovered with more or less useful limbs, and between 10 and 11 per cent. died. And although at least 9 per cent. of the deaths were due to tuberculosis of internal organs, which might have been prevented by early operation, I think we must admit that the results in these cases were very good, and such as might justify our abstaining from all operation in non-caseating cases. And if this is true of the hip, it is more so of other less important joints.

I think, then, that for the present at all events, we might make it a rule that, as long as there is no distinct evidence of the presence of caseation in tubercular joints, so long may we be content to wait while treating them by other means. But does the converse of this hold good? Ought we to operate early so soon as we are satisfied that caseation is commencing and advancing? This question, I think, it is quite safe to answer in the affirmative, except in very exceptional cases, as, for instance, where internal organs are also affected with tuberculosis. And I venture to think it is much to be regretted that this is not accepted yet as an established rule.

Taking Mr. Marsh's table of hip cases again for illustration, we find that suppuration was observed in 69.3 per cent. of the group not treated by operation of any kind. Here the mortality was high, namely, 33.2 per cent., as against 10.5 of the non-suppurating cases. Of the total of deaths, 25 per cent. at least died of general tuberculosis, probably many more; for, in another 25 per cent., the cause of death was unknown. Again, 31 per cent. at least succumbed to albuminuria and exhaustion. Now, it is fair, I think, to assume that an early excision in these cases before caseation had commenced would have almost or entirely wiped out the latter group; and, if so, it would have reduced the total mortality. And although there would be the set-off of the risks of operation had excision been practised, these would not at the present day go near to raise the mortality again to its original figure. But besides preventing albuminuria and dropsy, early excision would probably greatly reduce the mortality from general tubercular disease, although late interference might run some risk of increasing it.

In view of these and other considerations, I venture to think that it would be a wholesome rule that in cases where general tubercular disease does not contraindicate it, the infected tissue of a joint should be thoroughly removed so soon as it is suspected that caseation is advancing in it. Further, I believe that until some such rule is adopted as a general guide, improvement in the results of operations on tubercular disease of the joints will be very slow. Too often we see cases allowed to run on to the formation of large abscesses, with sinuses burrowing in all directions, which are only treated by excision when the patient is brought very low indeed, and where the prospect of thoroughly eradicating all the tissues infected with tubercle is very slender, while the risk of producing further infection is great. Moreover, the severity of such an extensive operation as is necessary in such a case often most seriously influences the general nutrition of the patient, and, if it does not actually destroy life at once, it goes far to render the system less able to fight against the inroads of pyogenic organisms, and against the development and spread of the tubercular bacilli already present in its tissues. In such cases of advanced

suppuration the proper treatment will either be to let them run their course without operation, but with every care as to general hygiene, or, in the case of the extremities (excluding the hip), to subject them to amputation, which, though it maim them, nevertheless preserves them in many cases from the risks of septic or tubercular infection, local or general, and from amyloid disease and exhaustion. They certainly are unfitted, in the vast majority of cases, for conservative operations of the nature of excisions.

Having now considered some of the main questions which, I venture to think, ought to influence us in treating this disease by operation, we turn to the consideration of the operative measures themselves by which we may hope to attain our object. In doing so I will for the present exclude the non-caseating group of tubercular joint-disease from consideration, and propose that we should limit ourselves to the operative treatment of those cases only in which definite caseation can be diagnosed in one or more tubercular foci about a joint. It is assumed, of course, that everything possible is done by rest and other appropriate general treatment to limit this degenerative change as much as may be; nevertheless, it is advancing. Can anything be done by operation short of actual extirpation of the diseased tissue to hinder the local disease? I fear not much. A great deal has been tried in the way of injection of various germicides into the diseased area with the object of killing the organisms which are producing the complaint, but so far the results have been very unsatisfactory. Injections of carbolic acid and bichloride of mercury have been employed in this way but without avail, and are now with one consent abandoned. In iodoform, however, there seems to be a growing belief that we possess a powerful agent for the destruction of the bacillus tuberculosus, and this may be brought to bear upon the latter in various ways. In the first place it ought to be noted that those who have employed iodoform largely in the dressing of wounds made in and about tubercular joints are almost all agreed that their results have been immensely improved, and, from what they have observed, are inclined to attribute this to the use of the drug. My own experience entirely confirms this view, and I am inclined to regard the free use of iodoform as one of the most important advances which have been made of late in the dressing of excision wounds for tubercular disease; but whether we can effectually employ it before the latter has reached the point requiring excision or not is another and an important question. I think, however, that we have now enough evidence of its usefulness in dealing with caseous tubercular foci elsewhere to encourage us to try its influence on the joints. Strumous abscesses have been shown over and over again to dry up and heal after repeated aspiration and injection with iodoform and glycerine emulsion, and I have myself had several cases of the kind. I think, then, that when there is evidence that a tuberculous deposit in or around a joint is softening into a cold abscess, we will do well first to aspirate all the contents of the latter through a large needle if we can, and replace the removed liquid by the now well-known glycerine emulsion, just as we do with a cervical or lumbar abscess. Besides its germicidal properties, which have been proved by experiment in such cases to be very great, this emulsion has, by virtue of its high specific gravity, the property of gravitating into the deepest parts of tubercular cavities, and even through thick deposits of caseous debris, which rise gradually through it until they float upon its surface. This can easily be demonstrated by half filling a test-tube with the contents of a strumous abscess, and then gently pouring in some of the emulsion on to the top. In a few minutes the position of the two fluids is reversed; the emulsion fills the lower half of the tube, the caseous debris has floated to the top. Now if this takes place in the body, and if the iodoform be a germicide, we have it brought into the most intimate contact with all the deeper parts of a tubercular cavity, and not only this, but as fast as liquefaction or suppuration takes place, the products of the process float up through the emulsion, and the iodoform remains below undisturbed. But while suggesting a trial of this method of treatment for early caseous abscesses, I should be very sorry to persist in it if there were evidence that the disease was steadily advancing in spite of it. I should in every case endeavour to forestall the bursting of an abscess and would operate.

This brings me to the consideration of the methods of actually extirpating tubercularised tissues. A joint has, we will suppose, been infected. There has been relatively slight injury; the first decided reaction has passed off, leaving the part swollen more or less, but with comparatively little pain. At this time there is probably no rise of body-temperature. The joint cannot be made

to execute all its movements to their full extent, except under an anæsthetic, but it is still used by the patient in a guarded way. Presently pain increases, and swelling becomes very evident. There is more decided fixation of the joint, and even under chloroform its movements are not free. A little later there is a slight rise of temperature in the evening, which recurs with regularity. A careful examination of the swollen part may now detect a certain amount of doughiness or deep fluctuation, or, at all events, a softness suggesting liquefaction of tissue at one spot or another. There seems to be good reason to believe that in a large proportion of cases uncomplicated by other disease elsewhere these two last symptoms commonly go together; that is to say, that there is usually no regular rise of temperature due to strumous disease of a joint, unless the process of caseation has begun and is progressing. Again, there is nearly always a regular evening rise when liquefaction is well advanced, and almost certainly when actual suppuration has been grafted on to the process of caseation.

Now in a case with the general outlines just given, in which we suspect that liquefaction has taken place, and where the ordinary treatment, including, perhaps, the injection of iodoform, has been tried, there may still be considerable room for doubt as to how far the disease has affected the ends of the bones or the synovial membranes—whether, therefore, an excision or a more limited arthrectomy may be required. Are we then still to wait and watch such cases until unmistakable evidence is at hand of extensive destruction of the tissues of the joint? Most decidedly not. Surely we are fully justified in making an exploratory incision into the articulation, in order to investigate the actual condition of things. Guarded by antiseptics we now make exploratory incisions in doubtful cases into the peritoneal cavity, the pleura, the bladder, and even into the brain, and we are certainly justified in extending this invaluable aid to diagnosis to the joints also. The risks are infinitesimal, with rigid asepsis and the use of Esmarch's tourniquet; the gain is immense, whether we suspect bone or synovial disease. Moreover, such incisions should be free, seeing that with the elastic bandage we need not fear bleeding. We know now from experience accumulated in the treatment of fractured patella and of loose bodies, that joints may be freely opened without the slightest damage to their functions, and where far graver issues are involved than in these last-named conditions, we should not hesitate to incise them widely for the sake of accurate diagnosis. We have furthermore the encouraging prospect, in a considerable proportion of cases, of being able to reach and eradicate a more or less local form of extra-articular tubercular disease, either in the synovial membrane or bone, without materially impairing the functions of the joint. Everyone who has read the record of them must have been greatly impressed by those cases occurring, for instance, in Koenig's clinic, and I believe paralleled elsewhere, in which joints have been opened for examination, and large wedges of redundant tubercularised synovial tissue been removed and the wound stitched up again, with the result that not only have the functions of the part been restored completely, but also that the disease has been arrested permanently, although probably all the tubercular tissue had not been eradicated. This experience is most remarkable, and would be almost incredible did we not know that a parallel is found in the case of general tubercular peritonitis. Many cases, you will remember, of the latter disease have been treated by abdominal section and cleansing of those parts of the cavity accessible to the operator, with the result of complete arrest of the disease, although there was no pretence that all the tubercular material had been removed.

We may therefore, I think, encourage one another to much freer exploration of joints by incision than we have hitherto practised, assured that, with care, there is little or no risk, and that much of the difficulty of diagnosis of tubercular conditions in an early stage will thus be overcome. This difficulty in determining the exact stage of the disease and its primary seat in a joint is, of course, one of the chief obstacles to our successful treatment of it by operation. If we could in all cases localise the primary focus early, we should be able in a very large proportion of them to extirpate it before it had infected the surrounding tissues, or had poured its virus into the circulation either through the lymphatic system or through eroded veins. Not only should this be possible, but it has been shown to be feasible without seriously impairing the functions of the articulation by many cases recently placed upon record by several surgeons, and notably by Koenig and Sandler, in the case of the knee. But unless formal exploratory operations are frequently resorted to at an early stage of the disease, such results will be few and far between.