TUBERCULOSIS
OF
BONES AND JOINTS.
The original work on which the following paper is based was done steadily and thoroughly in the course of the last three years but the rest of the paper has been put together with undue haste.

The subject is not exhaustively treated of; I have written more especially of what has come under my own observation; as bearing on this the recent literature has been largely borrowed from acknowledged.

The subject of treatment has been omitted but the principles guiding it, may, in many instances, be inferred from the facts submitted for consideration.

I have to record my best thanks to the Royal College of Physicians for allowing me to work in their laboratory, to the different surgeons of Edinburgh for the specimens without which I had been powerless, to Dr. Willie Scott and Mr. G. C. Ewing for the water-colours & drawings illustrating the pages of this paper & to Mr. P. W. Coghill of the Physicians laboratory for the manner in which he has executed the microphotograph.

A. A. Thomson

April 1889.
H. A. Thomson

1889.
The Anatomy of Tubercle in Bone

Tubercle in bone as in other organs shows a wide variation in its structure and arrangement. The secondary granulation of general tuberculosis will not receive description since it has but an anatomical rather than a surgical importance.

The bone lesions resulting from tubercular infection will be treated of under three heads:

1. The ordinary chronic focus or tuberclae-nodule
2. Tuberculous necrosis
3. Diffuse infiltrating tubercle

I. The ordinary Chronic Focus or tuberclae-nodule corresponds to that originally described by Milazon as the erupted form of bone tubercle. It is best seen in the spongy ends of the long bones or in the interior of the short bones. I show an example from each of these situations in Plate I.

In a recent specimen, to the unaided eye, they appear well defined, varying in size from a pin head to a cherry or larger; the periphery translucent, of a grey or reddish grey colour, the interior greyish or more often yellow from caseous necrosis, sometimes
soft or pulpy-like; on squeezing this between the fingers
fragmentary remains of bone trabeculae are usually felt
occasionally a sequester of spongy bone where the
focus has been of more rapid formation.

The yellow mass usually shows high distinctness against
the surrounding red marrow.

Microscopically these foci may be seen to result
from the grouping together & fusion of ordinary bone
trabeculae & granulations. The latter at an early stage
are almost exclusively formed in connection with the
walls of the arteries in the marrow; consisting in
the first place of a proliferation of their endothelium
or of that of the lymphatic surrounding them, so that
we get a mass of nucleated cells like those seen in early
labelle of the pia or peritoneum. See Plate II.
The arteries itself is usually filled by a granular debris;
these areas increase in size by peripheral growth,
replace the marrow tissue & fill up the canals;
the trabecular framework of the bone may persist &
die off if the sequence of events be rapid, usually it
is eaten up for the most part by the small round cells.

Towards the centre of the mass where the different
granulations have fused, caseous necrosis arrests
further development; towards the periphery, giant
cell systems are formed of very typical nature.
The margin may be fibrous, or it may consist of a ring of newly formed trabaculae enclosing the focus like a fence, or lastly it may be cellular with scattered granulations in the surrounding marrow, indicating the continued extension of the lesion. Plate III.

Such a focus reminds one forcibly of a syphilitic gumma. It is by no means the commonest manifestation of tubercle in bone. Occurring alone it has little power of destruction. Its pathological relationships and life history will receive notice after the remaining forms have been described.
II. Tubercular Necrosis of Bone

This term is applied to death of a portion of bone in mass, the dead portion retaining its original shape & framework.

Korin appears to have been the first to draw attention to this very characteristic lesion; he points out that tubercular necrosis differs essentially from that arising from other causes (osteomyelitis etc) in that the sequestrum remains in connection with the living bone, 

"It usually occupies the center of the bone & very frequently has the shape of a wedge, whose base is at the joint & whose after projects into the marrow thus resembling an infant." See plate

"As a rule the bone in which they lie shows no alteration in its external shape & requires to be sawn through before the lesion is recognized."

I propose to illustrate & describe three typical examples which have come under my notice.

The first (shown in Plate IV) is from a macerated specimen of a tubercular knee-joint in the University Museum (No. Y. 37) Towards the posterior aspect of the tibial condyle of the femur, the base of the wedge sequestrum is seen on the articular surface, separated from the surrounding bone by a distinct gap. The exposed
Surface of the lunate has not undergone destruction like the remainder of the articular surface but is dense, polished & churned like ivory. (The close similarity with the "precocious deposit" of chronic rheumatic arthritis had led to an erroneous description of the specimen in an earlier catalogue.)

The apex of the lunate projects into the spongy interior of the condyle, in which it is firmly fixed.

That this is a sequestrum is evidenced by the fact that it has escaped the destruction to which the surrounding living bone has so largely succumbed, moreover it is sharply defined from the bone in which it lies.

The polishing of its articular aspect is to be ascribed to the movement friction of the joint during life.

The second example is from the right hip-joint of a boy aged 10 who had suffered from "morbus coxae" for a year. When the upper end of the femur was excised by Mr. Wrench, the articular surfaces of the hip showed the superficial destructive changes usual in such cases. After taking the specimen to the laboratory I made a vertical section of the portion of femur removed & discovered the sequestrum shown in water-colour drawing in the recent state.
in Plate V. It looks at first sight like a large area of erosion but with the force or probe its true nature was once recognized.

It is wedge-shaped, the base corresponding to the epiphyseal plate, the apex pointing downwards towards the shaft. Its colour was dirty white or yellowish tinge; it consisted of compact calcaneous bone from which a little caseous pus could be scraped. It is limited both surroundings by a thin layer of grey gelatinous tissue in which a few vitreous bacilli were found in fresh conglomere preparations.

The sequestrum as a whole was separable on forcible handling. The remainder of the cervix consisted of inflamed a raw red spongy tissue of a red colour. Large sections were examined under the microscope:

The triangular area of the wedge seen to be defined from the adjacent marrow by a fibro-cellular tissue containing recent villous granulations. The area itself to be occupied by thickened trabeculae of bone dead and already stained enclosing confluent areas of cazeating vitreus fo the most part amorphous or granular, but towards the margins of the wedge showing granulation tissue structure with large giant cells.

The apex of the wedge is bounded by thickened trabeculae (see photograph Plate V).
when the base abuts on the epiphyseal plate the latter is completely metamorphosed and does not show a trace of cartilage. It consists of a badly stained, castellated granulation tissue (with a few blood vessels), shut off from the epiphysis of the head by parallel layers of fibrous tissue (see photograph Plate VI); its deep surface (next the bridge) shows the normal process of cartilaginous ossification, firm, as it were, by rapid death before destructive changes could occur, the outline being blurred, hazy, badly stained. (see photograph)

The third example was situated in the lower third of the shaft of the femur in a child aged 21 months in whom Mr. Bell amputated the thigh for Tubercular arthritis of the knee. The sequestrum was seen in the sawn section of the femur as shown in Plate VI, Fig. 3. of a dirty yellow colour & somewhat loosely embedded in caseous pus, occupying almost one half of the diameter of the shaft. A vertical transverse section of the lower end of the femur (Fig. 4, Plate VI) showed that the sequestrum extended downwards to within an inch of the epiphyseal plate, its long diameter lying in the long axis of the shaft. From it a sinus extended vertically downwards through the substance of the femur, into the cavity of the knee joint in which a secondary
authentic had resulted.

Sequestra are often met with in the Spongiosis of the os calcis asthma.

**Method of origin of the wedge-sequestrum**

Because of the resemblance of these sequestra to infarcts in other organs, the theory is advanced by König that the former are like the latter of embolic origin. He believes, "that plugs consisting of masses of cocccic material with bacilli are carried from the lungs or other organ, slip into the interior of a bone through its nutrient arteries and stick in a small branch; the bacilli become detached from the plug where impacted & penetrate the finest ramifications of the vessel, partly plugging these & partly giving rise to new centres of growth."

Here described in the case of my second example, how the entire area of the wedge becomes infiltrated with putridue & dies en masse, subsequent deposition of lime salts or it may be bone matrix on the trabeculae of the spongy bone so that the latter becomes dense & compact, being the only vital change that occurs, that chiefly at the margins of the wedge.

König's view is of course, supported by the usual position of these sequestra, viz. near the articular ends of bones & therefore at the terminal distribution of the nutrient arteries. I have not seen the plugged vessel at the apex of those sequestra but I believe König is right.
III. Diffuse Infiltrating, progressive Tubercle of Bone

This form corresponds to what Hilaté correctly described as “pureform infiltration.” It has its homologue in other organs e.g. pulmonary & renal phthisis. It is the common cause of what was formerly called chronic abscess of bone. It is most typically seen in the tissues spreading continuously from one bone to another, causing extensive cæsation destruction of the spongy bone (“caries”) & suppurating with formation of sinuses on the skin surface. It is a frequent cause of extensive destruction (“caries necrosis”) of the acetabulum. It is rarely seen in the long bones (a matter for congratulation) as it may extend to the medullary canal for an indefinite distance transforming the marrow into a caseous pulp & producing extensive destruction of the compact shell of the shaft (“caries necrosis”).

It is common in the phalanges of the fingers also involving the whole length of their interior constituting what König has called a true “osteomyelitis tuberculosa purulenta.” (Stimuous daeylitis, Spina Neulota).

This tubercular lesion differs from those previously described in that it has no margin of limitation. Its purulent miracle destroys everything. It the
walled eye it appears as a diffuse yellow infiltration of the spongious tissue, soft, caseous, with small points of pus formation or a more defined abscess cavity.

I show in Plate VII the naked eye appearances of such a lesion as seen in a section of the acetabulum; the specimen was removed post-mortem from a boy of 14 who died of tuberculous meningitis after hip-decree of 4-years duration, without any operation having been performed. The articular aspect of the socket was devoid of cartilage on one section of the bone this was seen to be due to diffuse caseous infiltration of the iliac segment especially.

In Fig. 2. Plate VII the same lesion is shown as it appears under a low power of the microscope (X14). The specimen from which this drawing was made consisted of a portion of the "wall" of an ill defined caseous abscess in the substance of the lower end of the tibia in a man of 64 on whom the Deanco performed a Sympathetic + hip section of tibia. An irregular area of yellow caseous infiltration is seen in the marrow of the cancellated tissue, embracing remnants of tracheulae in the shape of small sequestra, in the marrow beyond on a few scattered granulations around the blood vessels.
In Plate VIII. The margin of the proximal specimen is shown under a power of x70; it consists of a confluent tubercular granulation tissue, with few or ill formed giant cells; at the upper margin of drawing the structure is obscured by caseous necrosis.

The process of absorption of bone trabeculae is well brought out, little irregular pits being formed along their margins filled with small round cells. I have rarely seen "osteoclasts" or bone eating giant cells in such pits.

Relation of tubercle in bone to the nutrient arteries

I have described the three prominent lesions met with as a result of the entrance of tubercle into the interior of bone. It may be concluded that the infecting agent reaches its seat of development by the blood path.

It has been shown that the initial granulation, which, by their fusion constitute the gross lesions, are developed in connection with the smaller arteries. Further that the shape and position of the "tubercular-lesionarium" are strongly in favour of its embolic origin.

The normal blood supply to any long bone is conveyed to its interior by two sets of vessels.

There is a nutrient artery, piercing the shaft to ramify
Schematic blood supply of long bone
before union of epiphysis
in the medullary canal and there is a varying number of
central arteries which enter at the eponymous extremitics, usually
at the site of attachment of the capsular ligament + synovial
membrane of the adjacent joint; there, the so-called
articular arteries, supply the epiphysis with blood also the
synovial membrane connected thence with - Till adult-life
the medullary + articular systems are shut off from each
other by the plate of epiphyseal cartilage - (see scheme)

Infection through the medullary artery would appear
to be exceptional for but intramedullary lesions of the shafts of the
long bones are rarely met with; when they do occur they
are of a gross nature, either large sequestra or diffuse
intramedullary osteomyelitis. While the epiphyseal plate persists
such sequestra are situated on its epiphyseal aspect as a rule (Plate V) when it has disappeared, as is the
case in the adult, it is contained in the epiphysis
itself (Plate IV) in each example corresponding to the
terminal distribution of the medullary artery.

Infection of the epiphysis through the articular
arteries is by far the most frequent phenomenon and
affords an explanation of the prevalence of "bone-
arthrosis" in tubercle or lime tubercle as a separate
entity. That the synovial membrane is often infected
at the same time is easily understood, for both membrane
+ epiphysis are supplied through the same channel
The results of tuberculosis when deposited in bone
1. It may remain localized and undergo retrogressive change
which may lead to its cure. Small foci away from the
surface of the bone tend to such a course; the tubercular
tissue is replaced by healthy granulations which tend to
cicatrize. Sometimes the healing is not complete
a nodule of tubercle may remain behind, bacilli or spores
which may lie dormant for years and then recrudescence.
I quote from König, who calls such a relapse;
"Tuberculosis resided points out the importance thereof in the clinical history of joint inflammations.

Healing is less likely to occur in the case of large sequestra or diffuse infiltration with caseation. Nature is unable in the case of the sequestrum, even to cast off the dead portion because the granulation tissue concerned in this process, being infiltrated itself with tubercle has little vitality. Tubercle in bone rarely calcifies!

II. The focus may not heal but its progress may be arrested; it becomes shut off from the surrounding marrow by fibrous tissue or new bone.

II. If the focus lie near the surface of the bone, subperiosteal or subchondral it tends to invade or infect the surrounding tissues and cavities. The softer the original focus, the more likely is this extension to occur.

If the periosteum be involved: tubercular peritonitis results. It is common in the vicinity of joints. It is usually attended by superficial destruction ("peripheral caries") of the bone & production of abscess in the soft parts - (caries) - On the other hand one often meets with forming periostitis in the vicinity of tubercular joints, resulting in characteristic spines or corallike masses on the surface = inflammation without tubercles.
hastily the neighbouring joint may be infected and a tubercular arthritis result. Very little will determine whether tubercle in a bone will set up arthritis or an abscess outside the bone which latter may be periostal or parosteal. (König)

Method of spread from bone to joint.

It may be by direct continuity of tuberculous tissue (open) or as Hiesgen suggests a carriage of the bacilli from one to the other by lymphatics (?).

There shown in Plate 57 Fig. 1 a gross example of the former viz a sinus leading directly downwards from a sequestrum in the bone shaft of the femur into the cavity of the knee. Such examples might be multiplied — many of the knee joint specimens in the Anatomy museum might be cited.

The infection is usually on a smaller scale and may be traced with the microscope in sections.

When the bone focus is sub-chondral, the cartilage is invaded from beneath by the granulation tissue at the margin of the focus. It becomes thinned and foetid, later on in fact. The cell spaces of the cartilage previously become enlarged or filled with small cells while the matrix is absorbed (see photographs opposite). If the cartilage cells live they may join the ranks of the invading cells. Lastly the cartilage is perforated — the "bone-derived"
granulations sprout up through it as little vascular points or as "fungating masses." ("ulceration of cartilage")

General activity may be prevented at the moment of perforation by localized formation of inflammatory connective tissue. (König)

The cartilage may be only eaten up in part or it may be lifted up in mass & separated from the subjacent bone. (see head of femur plate 18) ("necrosis of cartilage")

The cartilage "gone", the bone granulations sprout up all over the articular surface as a soft straggly layer embracing the eroded & broken up trabeculae of the surface bone. ("arthritis sicca or ulceration of articular surface") This condition is illustrated in the photograph opposite.

There is some difference of opinion as to the exact nature of the bone granulations so glibly referred to in the above description. Both Volkemann & König assert that the tissue beneath the cartilage & perforating the latter is of ordinary granulation tissue type & not tuberculous (though occurring in a tubercular joint). This appears to be so on microscopic examination because the perforating tissue is so endowed with vitality & blood vessels but I have seen scattered the characteristic giant cells etc. I have found lose bacilli in this tissue. The truth would appear
to lie somewhere between the two views. It is of tubercular origin but becomes added to by products of "simple" inflammation, which may obscure the former.

Lonig terms this process "common surface ostitis of articular ends."

If the focus lie close to the Synovial Attachment then is secondary infection of the membrane spreading through out its extent as arthritis.

Tubercular focus from a rotated focus in either situation in bone, when it escapes into the joint cavity direct, sets up a more acute form of arthritis; this latter method of infection is rare.

I need scarcely point out that fori morti occur primarily in cartilage. The latter plays a negative part.
The Anatomy of Tubercle in Synovial Membrane

This cannot be summed up as formerly in the one term "tuberculous degeneration". There are three main types-

I. Diffuse miliary Tuberculosis.

like the same lesion in the pleura or peritoneum but occurs in the absence of general tuberculosis in other the body. It is of surgical importance for it shows itself clinically as synovitis which I have seen mistaken for that called gouty.

So far it has been only described in the knee & it is rare, as a solitary affection.

The membrane is slightly thickened, its surface is studded with miliary granulations, looking like small sage grains under the endothelial lining, of a grey or yellow colour. They are best seen around the patella. There is increased vascularity of the membrane. The joint sac is filled as a rule with turbid synovial fluid. (hydrorheuma or synovitis)

Microscopically, the granulations are in the superficial layer of the membrane & consist of spherical aggregations of small cells surrounding the vessels. little or no inflammation of surroundings. I have not seen giant cells in the granulations but they tend in their centre to myeloblast or caseous necrosis.

The fluid in the joint referred to above may be serious
or sero-fibrinous with flakes of synovial or it may be
gummatous in which case the membrane is covered with a
layer of fibrin (pyogenic membrane).
In one only specimen which has come under my notice
the bones of the knee joint were absolutely normal, while
the cartilage covering them was slightly macerated by
the fluid... (The case is detailed under clinical features
later on).

II. Tubercular inflammation of the
synovial membrane or so-called gelatinous
degeneration.
This form so predominates in frequency over the others
that the term “gelatinous degeneration of the synovial
membrane” has long been synonymous with “tuberculous
activity.”

1. It may be the primary and only lesion in a joint—my case.
2. It may be simultaneous with bone lesions, the double
infection occurring through the blood-ducts, as already
described—very frequent.
3. It may be secondary to bone lesions by direct
extension from the latter, when situated near synovial
attachment or from perforation of subchondral
tissue through the cartilage into the joint cavity.
Its homologues elsewhere in the body are tubercular
pleurisy, tub. peritonitis etc. as distinguished from
Submucosa of the Membrane Pure & Simple

Appearances: The membrane becomes enormously thickened by inflammatory changes throughout its thickness and in the tissues beneath it; it is greyish or whitish in color, soft & lymphatic or oedematous & gelatinous; at its free margins it tends to form papillary fringes in which haemorrhages are frequent. Occasionally one may recognize tubercular granulations on its surface like small rago grains. Fibria is deposited on the joint aspect, becomes adherent & organized from beneath, the ligaments & intra-articular fibro cartilages become incorporated with the synovial tissue as the latter grows inwards from the periphery between the articular discs & covers their articular surfaces. The one layer may be completely shut off from the other in this fashion (knee), and may move or crumple if the joint is occupied.

When it lies on the articular cartilage for any time the latter may be transformed into connective tissue which fuses with the synovial tissue or it may be eaten up & penetrated by the synovial granulation tissue which in this way reaches the subchondral marrow; if the latter be form the outlet, the bead of tubercular granulations, the cartilage is more rapidly destroyed or separated by the double invasion. The synovial tissue has a greater power of invading
the cartilage as the fineliness of the articular surfaces, that its
thin prolongations over the central area.

In the fringes one may find small sebaceous points,
the substance of the membrane generally, one may
find large sebaceous areas or "alveolae".

There is rarely pus in the synovial sac itself!

There may be a little turbid synovial fluid with flakes of
lymph, when pus is present the surface of the membrane
has a granulating appearance like the floor of an ulcer.

Microscopically:

The appearances vary; the basis of the whole is a
loose connective tissue with a large number of newly
formed blood vessels, partly engaged in organising
the fibrin on the surface; beneath is the cellular
synovial tissue proper. Throughout this tissue,
but especially towards the free surface & in the most
distant fringes, are nucleated follicles, isolated or confluent,
with perfect giant cell reactions as a rule.

While ligaments or intra-articular cartilages are involved
their fibrous bundles are separated & split up by
columns of cells & ultimately escape recognition.

Very prominent, in the deeper layers of the tissue,
is seen Endarteritis Obliterans of the large
arteries belonging to the synovial membrane.

In its earlier stages it consists in a cellular thickening
of the intima so that the lumen is narrowed upon from one side. Calcification may be completed by thrombosis.

At a later stage in the process, the granulation tissue of the intima invades the media, splitting it up and then infiltrating the adventitia until what was once a blood vessel comes to look like a solid circular mass of small cells, amongst which fibrillar remains of the internal elastic lamina may be recognised.

I have not seen any degeneration of the vessels.

I have not seen the acute inflammation described in synovial membrane; it is in my experience one of the most constant accompaniments of tubercle in this membrane. I have seen it, further, in the radial tubular arteries within branches in tubercular disease of the wrist.

It must exercise a deleterious influence on the processes of nutrition and repair.

The tubercular areas in the synovial tissue may be isolated linear granulations; these are usually around the organising blood vessels towards the surface of the membrane. More commonly they are well developed tubercle follicles, isolated or confluent; in the larger areas there is caseation and disintegration in their centres.

The "Giant-cells" are frequent and numerous.
They don't appear to be cells at all but hyaline coagula in the intestines or lymph spaces of the tissue. Their shape depends on that of the space in which they form; round or oval nuclei are entangled in the coagulum when it forms; subsequently, the clot contracts leaving peripheral extensions of the substance as processes.

These "granul cells" are not the leuk like the osteoelast of normal marrow nor the large cells of a myeloid sarcoma, although an American reviewer of König's book, expresses his surprise that "König omitted the caution that granul cells are not frequent occurrence in sarcoma as in tubercle." (Comment Munro needless!) I am not familiar with endothelial cells surrounding the granul cell.

In a few cases of synovial tubercle the "granul cell" is a cross section of a blood vessel.

Perhaps I should state that in 54 joints (Stimmer) submitted by myself to microscopic examination such appearances as above described were present in every case in the synovial membrane for they are all examples of arthritis.

The above description applies especially to the knee joint in which "gelatious degeneration" shows itself at its best!
"Nodular tubercle of the synovial membrane" is a third form first described by Riedel*. [A full account of this is given in Krings book.]

It, like the first variety, is practically confined to the knee joint; clinically it resembles, has been mistaken for, rheumatic synovitis; anatomically, the membrane resembles that of arthritis deformans.

The same condition has been described by French writers in the sheaths of tendons under the name of "Tuberculose tendo-vaginale." "Fungouso Bursitis" etc. (Lanceaux, Trélat & others).

These met with two typical cases in the knee during the last three years.

The synovial cavity is filled with a pale turbid fluid (hydrops) containing soft white, lymphoid masses of considerable size or it may be firmer bodies with cartilage or even bone in their interior (loose bodies). Riedel describes melon seed like bodies.

The membrane itself is much thickened and firm consistence. Its free surface is thrown into fringes & folds like a cauliflower which overlap the articular surfaces but are not in contact with the latter nor do they become adherent to the cartilage. There may be pedunculated excrecence and nodular masses on the surface, appearances hitherto regarded as characteristic of arthritis deformans. See plate X.

Microscopically there is a layer of fibro on the surface
infiltrated with small cells, beneath this there is a thick layer
made up of young blood vessels & lymphoid cells lying in
a loose connective tissue resembling the organising layer in
a serous membrane inflammation. The cells are here & there
 grouped into definite milk-like granulations; the cells being
closely packed & undergoing hyaline necrosis in the centre
of the mass (see plate XXI). The cells are also closely packed
around the young blood vessels.

I examined the loose bodies in both cases; in one
the soft lymphoid masses like clots each contained a mass
of fibrocartilage indently derived from the synovial cartilage
covered by a layer of synovial granulation tissue & organising
fibro, infiltrated with recent tubular granulations & areas
of haemorrhage. There can be no doubt that these bodies
were originally sessile on the synovial membrane & became
subsequently detached so as to float free in the synovial effusion.

In the second case there were nodules of hyaline cartilage
and of bone in the interior of the loose bodies.

To Riedel is due the credit of observing in the first place
"that seed-like bodies, & other fibrinous formations are
phenomena of chronic tuberculous inflammation."

Koch regards the above described form of synovial tubercle
as a localized tubercular infection of the synovial membrane but he does not state whether he submitted the cases of his cases to minute examination. In both examples observed by myself there, gross tubercular lesions of old standing in the femur in one case — in the tibia in the other. I am not prepared therefore to agree with König.

It may be convenient at this stage to consider the changes in the

**Epiphyseal Cartilage**

in Tubercular arthritis.

Its invasion and destruction by tubercular lesions in the contiguous bone has already received attention. I beg to draw particular notice to the fact that its bone-forming function is frequently arrested in tubercular arthritis apart from the presence of any tubercular deposit in its vicinity.

The sharp aspect of the plate as shown in the photograph is covered by a crust of recent bone or calcified cartilage which stains more deeply than the plate itself, this is no cell proliferation in rows or development of new bone to replace as there is in the normal state.

It may be regarded as a formative ossification of the plate as a result of interference with its nutrition brought
about by superadded inflammation; analogous to what is seen syphilis, rickets etc.

Amoeboid growth in the long bones of the limbs in tubercular arthritis has been observed clinically by Dr. Duncan and others.

The retention of the epiplapral plate has been urged as one of the advantages of arthrodesis over complete excision in the case of the child especially.

**Periarticular Abscess.**

Under this term one includes those abscesses which develop in the course of tuberculosis of the joints, commonly called "syphilitic" or "cold abscess." In speaking of "abscess" it is difficult to define when the liquefaction of tubercular caseation begins and the liquefactive and proliferative processes concerned in true suppuration begin. "It is difficult to understand why in some cases one should have extensive lesions in the component parts of a joint with scarcely a drop of pus while in quite a small focus in bone an enormous abscess may result. [The latter condition is frequently observed in the spine (vertebral tuberculosis).]"
It has been supposed by some writers that the occurrence of suppuration in tubercle is due to an additional infection such for instance as Koch describes under the term "Mifex-Infection" where tubercle bacilli and ordinary micrococci co-exist. Experiments on animals with pus from closed tubercular abscesses, human, in the hands of Loeffig, have failed to give rise to any other infection than the former tubercle.

Clinically one rarely meets with true pus in tubercle of bone or joint until the surrounding soft tissues become infected and ordinary suppurative inflammation is superadded to the tubercular process. The pus resulting from this combination has infective properties in the highest degree; whereas it may not give rise to new tubercular granulations till a stage is reached when the resulting collection of pus is termed an abscess. The wall and contents of the latter resemble tubercular abscesses in either situations; one need only emphasize the fact that an abscess outside a bone or joint is due to the deposit of tubercle in the periarticular tissues. This deposit may be primary or it may be secondary. In the latter case it follows upon foci in the adjacent bone or joint by direct continuity of tubercular tissue or by lymphatic extension.
Diest retention from a focus in bone would appear to be the origin of most of these abscesses. How frequently one finds on passing a probe down a sinus in the region of the knee, that it reaches a "cavious area in the femur; in the region of the hip to diseased bone" in the acetabular margin, femoral neck or great trochanter outside the joint; in the region of the ankle, to one of the tarsal bones.

Moreover in many cases in which this origin exists the probe may fail in its demonstration by reason of scarcity of the track or its blocking by debris.

I have rarely seen the probe pass directly into joint cavity!

In making large sections for the microscope of joints where sinuses are present one is struck by the absence of anything like an open or patent channel in the situation of any sinus: On the contrary it is usually a solid tract of yellow tissue from its origin in the bone until it opens on the skin surface, macroscopically this consists of an organising granulation tissue permeated by tubules, the blood vessels being either filled up by a yellow lipolitic infiltration or obliterated by endarteritis. When a probe is introduced into such a sinus, it easily penetrates this soft tract of tissue.
I will now discuss the relation of Tuberculosis of bone and joint to tubercle elsewhere in the body, and to General Tuberculosis.

Is Bone-joint Tubercle primary or secondary? It is difficult to decide this question by clinical observation. Direct primary infection of a joint through a wound is so very rare that only one or two cases have been recorded. Post-mortem examination of cases of Bone-joint Tubercle throws some light on the problem before us.

Kroeg gives the results of 67 sections on cases which died, for the most part, after operation into bone at the Göttingen clinic during the eight years preceding 1884. In 14 or 21½%, there were no old foci in the body that might have served as sources of the bone or joint disease.

53 or 79½% there was in the body an old focus that had served as a source of the bone or joint.

Irene concludes that most Bone-joint Tubercle is secondary or metastatic. The primary focus is most commonly in the lung or bronchial glands.

I have seen 7 such post-mortems in Edinburgh and in every one there was an old focus capable of acting as the primary lesion. In 5 this was situated in the apex of the lung, in 1 in the kidney, in 1 in mesenteric glands.
In two of these cases the sequence of events was discernible from the clinical history. In the urinary case the patient suffered at 12 years from bladder symptoms, at 17 years the suprapubic pain and a tuberculous arthritis developed, died at 19 years; a sepsis revealed tuberculous pyelo-nephritis and ulceration of the bladder floor. In one of the lung cases the boy at 8 years had a low form of pneumonia from which recovered but 2 months later, while going about, disease of left hip began spontaneously; on sectis a cheesy encapsulated nodule the size of a pea in the right aper.

In 30 cases which did not terminate fatally, I found traces, clinically, of an antecedent tuberculous focus, in 14. In seven of these, this consisted in suppurating cervical glands with persistent c-reactives. The primary focus may precede the joint lesion for a period ranging from 6 months to 50 years.

One cannot but reflect on the frequency with which an antecedent lesion may escape recognition during life; we cannot diagnose a cheesy lymphatic gran ulceration bronchial or mesenteric as more than we can a quiescent focus in the afrent of a lung.

Writers from all times have pointed out the latent danger of a cheesy deposit wherever located.

It is difficult to imagine that the focus called primary in the aper, 0 that resulting in the knee-joint
disease, were simultaneously deposited from the first
that the latter lay dormant for an indefinite period.

I have already stated that injury supports their
metastatic origin; he further believes that injury of
the joint frequently brings about the metastasis. He
enumerates the following law: that traumatic joint-
lesions are usually metastatic. In 1878 Max Schüller
made some experiments which go to support this proposi-
tion; he caused healthy animals to injure or inhale tubercular
matter and then inflicted various lesions or injuries about
their joints. Around every point injured under these
circumstances there developed a tubercular eruption,
while the animals themselves rapidly succumbed to general
consumption.

What part does the injury play in the metastasis?
A strain, contusion or fracture causes interstitial
haemorrhage, vaso-motor paralysis, oedema, & fluid
exudation, into the tissues. What could be a more
favourable nidus for the bacilli than the embryonic
connective tissue resulting from the above?

When there is no history of injury one is obliged
to fall back on the predilection of the parasites for certain
tissue areas amongst which the marrows of spongy
bone with its terminal blood supply stands
preeminent.
Method of Metastasis from Primary Focus to Bone.

When a cheesy nodule in lung or gland softens the contained bacilli (or spores) may be absorbed by blood vessels or lymphatics, in either case they enter the circulating blood, & may infect one joint or several joints simultaneously or in succession provided milking tuberculosis do not occur, remedy of the patient. Why to the latter alternative, the exception rather than the rule is our difficulty.

Klein believes milking tuberculosis to be common both that it may be recovered from & recede, leaving one or two foci to develop further. Such has shown that the results of inoculation with bacilli in animals vary according to the number introduced in the channel chosen whether directly into the blood stream or only reaching the latter secondarily.

Probably only a few bacilli are absorbed from any quiescent focus, too few to originate general tuberculosis, but sufficient to set up bone joint disease if tissue predisposition & traumatic nidus be harmoniously combined so as to favor their development.

Multiple metastasis is probably the explanation of the disease lately described by Mr. O'Brien under the term "Subcutaneous arthritis form."
which has many affinities with acute articular arthromiasis & pyrexia. I will not describe this manifestation of tubercular infection in detail but will cite two cases by way of illustration.

(1) A boy of 13. An ecruceous symptom appeared on the ulna, after which tubercular arthritis appeared in succession, tubercular laraes of the crest of the ilium with abscess, of the right frontal bone, of the dorsal vertebrae with angulella curvature of lastly suppuration in the left submaxillary glands. The sequence of events in this case is clear: absorption of infective material followed the first eruption into the bone and a smear of bacilli descended on the various sites above mentioned.

(2) A girl with tuberculosar of bladder & kidney, developed symptoms like acute articular rhyming. Here in both hips, one knee & one shoulder with high fever which ultimately became of hectic type. One of the hips went on to suppuration & was shown to be tubercular on excision.

I could cite other illustrative cases but will content myself with quoting one from Horsig: "a patient with tuberculosa pyelo- nephritis + cytitis, after a severe urinary (? ) rigor, pointed
out the painful site in which tubercular metastases developed in the course of the next few weeks.

I am of opinion that many cases of tubercular arthritis said to have followed on a rheumatic fever or rheumatic arthritides, are to be explained in this way.

It should be borne in mind that at every tubercular metastasis the patient runs the gauntlet of general infection.

Bone-joint Tuberculosis a cause of General Tuberculosis.

I must first show how the infection extends to the rest of the body from its seat in the bone or joint. In the first instance the lymph path is the channel of conveyance in the majority of cases. In bone joint tuberculosis of the extremities the lymphatic glands alone are commonly enlarged. Koch has found the bacilli in the supratrochlear gland in disease of the wrist(1) and the axillary glands in a case of supraventricular sheath tubercle of the finger. König records tubercle of the patellæ, spread through the acetabulum from the hip joint(2).

(1) Micro parasites in Disease page 170.
(2) ib. page 196.
the peritoneum to the pleura or lungs, etc. etc. From the lymphatics the bacilli readily escape into the blood stream, and a general erysipelas results chiefly on the serous membranes, death usually following on symptoms of tubercular meningitis.

Absorption by the veins undoubtedly occurs; it is probably the rule in cases in which the general infection follows with great rapidity on operative interference, the latter having the effect of destroying the limiting barrier which confines the bacilli & thus allows of their being sucked up by the veins.

Fortunately for surgery, general tuberculosis follows very rarely on operative interference & further since successful asepsis has become the rule rather than the exception, it is much rarer now than it was some time ago. König's statistics are pregnant with interest in this relation. Up till 1882 he had 16 deaths from general tuberculosis out of "many thousand cases" deaths usually followed on operative interference; (after 8 or 10 years natural) 11 of the 16 were septic deep in the hip, all suppurating, all septic, together with remodelling of tibiae in the operation wound.

Since the perfection of antiseptics in his hands, he has only had one case during the last 2 years. *

* American review of König in Annals of Surgery, mistranslates this passage; he states König has not had a single case.
The kind of lesion in bone to set up general infection is the soft caseating focus or the diffuse infiltrating tubercle. Such is a frequent lesion in the hip joint usually involving the acetabulum, if one remembers the close relation of the latter to the pelvic peritoneum one can understand how general tuberculosis follows more frequently on hip cases than on other joints. Moreover abscesses are espec. frequent in hip disease, hence sinuses and septic infection superadded.

I have only examined one case in which death was caused by general tuberculosis of the acute form; a boy of four with hip disease and septic sinus, in whom no operation was undertaken; the lesion was a diffuse caseous infiltration of the acetabulum.

Suppural tubercle does not appear to give rise to general infection.

I quote Wartmann's statistics of excision of the hip, which embrace 837 resections; "in at least 10% of the total deaths after operation, miliary tuberculosis supervenied in such a way as to strongly suggest that the surgical interference was the exciting cause of the generalisation of the disease."

I am of opinion that tuberculosis after operation has in the past been frequently looked upon as
Clinical Features of Bone-Joint Tuberculosis

It has been seen that, anatomically, the osseous factors preponderate because the great majority of cases of bone tuberculosis do not betray themselves except by the arthritis to which they give rise; clinically, the tendency is to direct attention more especially to the affected joint.

I cannot, within the limits of the present paper, discuss the manifestations of tuberculosis in the shafts of bones but I will venture to affirm that the majority of cases assumed variously "necrosis of the femur etc, chronic osteitis etc. are of this nature. Syphilis, traumatism & infective periostitis or osteomyelitis are to be credited with a very small proportion of these shaft caries & necroses - very much smaller than our museum collections would lead one to infer.
The clinical features of bone tubercle in the vicinity of a joint before the latter is involved, such lesions are called in the devotees, "serpulous peristitis, caries, necrosis," "Brodies abscess" etc.

Tubercular periostitis of the end of a long bone ("stromous node) shows itself as a localised painful or tender swelling of slow development, ultimately becoming soft & boggy when the stage of cold abscess is reached; the sensation given to the fingers has been compared to a cephalhaematoma, soft in the centre & firm at the periphery from periosted ongrowth. The abscess bursts in a painless, indolent fashion or granous or caseous flaky pus escapes; a probe passed down the resulting sinus impinges on disintegrating bone = "peripheral caries."

Tubercular ostitis in the interior of the articular end of a long bone is a more obscure affection; its development may be so chronic insidious that its presence is often entirely unsuspected until the adjacent joint is involved. In the femur it is most typical at its lower end, in the tibia at either extremity, in the humerus at its upper end & in the radius where it enters into wrist-joint.
It was in the tibia that Brodie first described this affection as "chronic abscess of the interior of bone."

Pain may be absent, or may be dull aching or "perpetual descreetitating."

Enlargement of the end of the bone in a uniform manner is to be measured by callipers as the eye and hand are apt to be deceived by atrophy of muscles or joint swelling. The bone is expanded rather than thickened and its natural form retained.

Tender points on the bone, especially if associated with softness and compressibility justify one in confirming the diagnosis by operative interference.

Tissue need not be present unless pus has formed.

Any of the following lesions may be discovered by operation: a localized collection of caseous pus in the interior of the bone = "Brodie's abscess"; "chronic un鏽scribed suppurative osteomyelitis" of other vertebrae, or a diffuse caseous infiltration of the spongy bone which may extend along the medullary canal (tuberculous osteomyelitis) until it may be necrosis of the external shell of the bone, or lastly a large sequestrum of the "wedge variety" in the substance of the cancellated tissue = "carious necrosis." In the circumscribed "abscess" abscesses of the surrounding bone is a frequent concomitant.

When the external shell has been extensively destroyed
a new case may be formed around the latter by the peristernum as in traumatic "acute necrosis".

The abovementioned lesions are familiar to every surgeon but they are usually described by terms which leave their origin in the student mind at any rate, a matter of uncertainty. Subcutaneous necrosis, however, as previously pointed out differs from other forms in that the sequestrum remains connected with the bone in which it lies and does not therefore reveal itself as dead bone in the palpable fashion of sequestra arising from other causes e.g. suppurative periostitis or osteomyelitis. The probe or finger would fail to identify it, the sharp spoon would give one the erroneous impression of living sclerosed bone: as Nevin has pointed out it requires a chisel or mallet for its enucleation. I have never seen this sequestrum recognized until the bone in which it lay has been removed in mass or seen in section.

While it is to be regretted that we are unable to diagnose this special lesion, it is at any rate a step in advance to be aware of its existence and to know something definite of its pathological anatomy.
I. Clinical features of the lesions included in the term "tuberculous" or Tubercular Arthritis

This affection preponderates over all other forms of Surgical Tuberculosis; so any one not familiar with the contents of a surgical ward of the Royal Infirmary an idea of the prevalence of this form of arthritis may be best conveyed by stating that out of 1000 consecutive admissions to Dr. Duncan's wards 170 were cases of joint tubercle; further, this number does not include the large number of elbow, wrist, and finger cases which are in the main treated as out-patients. A little reflection brings out the fact that joint diseases of other origin are rare!

The number of tubercular cases is, if anything, on the increase. I will show later that several cases admitted as "rheumatic" or as "irritational" ultimately showed themselves to be tubercular. Chronic simple synovitis is undoubtedly tuberculous in many instances.

It will be inferred from what has gone before that the clinical picture of tubercular arthritis may present the widest possible variations; these will be grouped into three classes for the purpose of convenient description and throwing into prominence certain outstanding clinical features.
Firstly one must consider the relative frequency with which tubercular arthritis originates in bone or in synovial membrane. I have been struck by the dogmatic position taken up by different observers on this question as if one could say with precision in any case — this has been primarily in the bones or vice versa. I agree with Allier when he says: "Cette question n'est pas facile à résoudre; même lorsqu'on a sous les yeux les pièces osseuses qu'on veut d'enlever par la résection on ne peut toujours se prononcer sur la succession des lésions."

The more experience one has, however, of the real sequence of events, the more one is able in any given case to recognize or at any rate suspect the true origin of the disease.

To make statistics from cases of excision is not an absolutely reliable performance but those compiled by Dr. Müller from Kö nig's preparations at Göttingen appear to come very near the truth.

In 232 cases the primary seat in 158 was in bone

46 — Synovial Mem.

28 — doubtful

Excluding the last-mentioned these figures indicate that 25% of all joint-tubercle cases originate in the synovial membrane.

* Transactions Medical Congress - Copenhagen 1884.*
<table>
<thead>
<tr>
<th>Cases</th>
<th>Primary Seat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder</td>
<td>Ossseous</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Elbow</td>
<td>8</td>
</tr>
<tr>
<td>Wrist</td>
<td>2</td>
</tr>
<tr>
<td>Finger</td>
<td>2</td>
</tr>
<tr>
<td>Hip</td>
<td>10</td>
</tr>
<tr>
<td>Knee</td>
<td>19</td>
</tr>
<tr>
<td>Ankle &amp; Tarsus</td>
<td>11</td>
</tr>
<tr>
<td>Toe</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>54.0</td>
</tr>
</tbody>
</table>

or

Primary seat in bone in 80%  
Membrane - 20%
My observations have necessarily been confined to a small number of cases but they are more accurate and much as every joint made use of has been submitted to complete microscopic examination moreover a considerable number of my specimens were not obtained by section but by amputation and post-mortem examination.

In 54 joints (excluding vertebrae in which the primary seat is always in bone)

the primary seat in 43 was in bone

- II - Synov. mem.

By primary is meant the chief or gross lesion in the particular joint, not the only one for in every case there was microscopic tubule in the Synovial membrane.

My results give therefore 20% of primary Synovial seat as compared with König 25%, a very satisfactory microscopic corroboration of naked eye examination.

The proportion varies in the different joints: König gives 32% as the average of primary Synovial injection in the knee, 6% in the hip, 20% in the elbow. I submit in tabular form opposite the details of the 54 joints alone referred to, which corrobore the proportion as stated by König. I might have made use of several hundred museum specimens in Edinburgh.
but I deemed them unsuitable for determining this question because of their selection for demonstration of special manifestations for teaching purposes.

It is generally stated that arthritis originating in bone is the rule in children while the reverse is the case in the adult. (Vollmann, Eller et al.) I cannot agree with this generalisation which I believe has been based on the fact that bone lesions show themselves more rapidly and more prominently in the child than in the more frequently recognized

The arthritis resulting from tubercle may be divided for clinical purposes into three main types:

1. Synovitis or hydrops
2. Fungating arthritis or gelatinous degeneration
3. Foululent synovitis or joint-empyema

These manifestations may be combined in any one case or they may constitute stages in the clinical history of a joint because the lesion "tubercle" is common to all.

I type of joint-tubercle: Tubercular Synovitis: The hydrops tuberculosus of German writers. It is very rare and frequently escapes recognition. It is chiefly seen in the knee. The patient may have a tubercular Konig
history family or personal & his knee may have been injured. The joint becomes gradually filled with fluid without pain or without fever. The synovial mem-
draw may show scarcely any appreciable thickening or it may be thickened, modulated or even between the masses may be felt. As a rule the function of the joint remains perfect over a long period or there may be some cranking on movement from the presence of
fibrous clots floating in the fluid. Loose or peduncu-
lar bodies may be discovered in some cases either by
the patient or the surgeon. The amount of fluid in the
joint varies from time to time according to the amount
it is used; under rest it rapidly diminishes.
The disease is very chronic, frequently lasting for
two years or more and is apt to merge into the
more familiar arthritis of tuberculosis (wasting of muscles of limb).

On incising the joint, a pale turbid synovial fluid
escapes containing soft membranous clots, melon-
seed like bodies or organized loose bodies. The
synovial membrane itself may show
1) diffuse minute granulations like sago-grains
on its free surface without appreciable thickening
of its substance (see case I below)
2) the same granulations may be present together
with considerable thickening of the membrane
the latter showing hypertrophied fringes & folds or it may be pedunculated masses or layers of fibrin on its free surface, from which the fibrinous clots, sudden seeds & the loose bodies are derived (see Plate XI page 26).

3) Tumour-like masses in the synovial membrane formed by fibrin deposit & organisation but containing caseating tubercle = "das tuberculöse Synovial-Fibrom" of Riedel, König etc.

4) Rarely does one find the fungating synovial membrane, bone or gelatinous degeneration in a hydrops-

In any case I have examined microscopically there was tubercle both in the membrane itself & in the loose bodies. In one case only were the bones normal, in two, there were large foci in the articular ends.

König cites seven cases but omits all mention of the bones entering into the affected joint.

I will now detail the three cases belonging to this type which have come under my observation.

Case I Tubercular synovitis of knee: Death P.M.

Mrs Jessie Lawson aged 19. Her father died of phthisis & two sisters of "watery in the head" (tubercular meningitis). In 1881 she was treated in the Infirmary for pain in the bladder & dribbling of urine. In August 87 she sprained her right knee which gradually filled...
The patient recovered in February 88 and shortly after her bladder trouble returned and she was admitted to the Medical Wards with pain and frequency of micturation; while under treatment her right knee again became swollen and painful.

The case was diagnosed as "gonorrhoeal cystitis and synovitis"!  The patient was transferred to the Surgical House in October 88.  The urine was alkaline, contained pus, albumin & a little blood.  The right knee was swollen in the shape of the Synovial Sac fluctuated with floating patella but no pain or redness apparent.  The joint stiff from long retention in the semiflexed position.

Dr. Dunnigan regarded the case as tubercular and did not interfere surgically.

Therapy soon developed an intermittent high fever, with a rash like measles on the anterior surface of the body, followed by abundant desquamation, malar flush, emaciation, unclouded intellect, died 9th Dec. 88.

Post mortem examination revealed, tubercular ulceration of the floor of the bladder with scattered miliary granulations, tubercular ulceration of the right ureter & tubercular peritonitis on the right side.  The right knee-joint contained a quantity of turbid synovial fluid with large flakes of lymph;
The synovial membrane was scarcely thickened at all and was studded with minute granulations like small granules, especially in the upper recess around the patella. The ligaments were intact. The cartilage surfaces were free from abnormal condition as seen under microscopy.

The membrane showed under a low power, a layer of badly stained fibrin on its free surface, a number of scattered minute granulations, some caseated, others with abundant giant cells, chiefly in the superficial layer of the membrane, lying in a loose connective tissue containing many young blood vessels like an organizing serous inflammation. In the deeper layer there was early endarteritis in the arteries. I did not find any bacilli but did not examine many sections.

Case II. Tuberculous synovitis merging into arthritis:

Incision of knee joint - recovery.

Mrs. Coots aged 30 admitted Ward 17 Roy. Inf. 5.12.88. Her family and personal history impregnated with rheumatism. Her left knee had become painful in February 88 but she continued her work for several months. The knee was diagnosed to be "Chronic rheumatism" by her own doctor. On admission the joint was much swollen, partly fluid, partly solid, of synovial shape, fluctuation indistinct. There was some pain on movement.
and starting at night. The thigh calf muscles were atrophied.

Mr Miller, after an exploratory incision, excised the knee on the 11.12.87. A considerable quantity of turbid synovial fluid escaped with several large soft membranous clots. The synovial membrane was a fluid red colour, enormously thickened, thrown into folds and fringes like a cauliflower. See plate X on page 26. After sawing through the bone end of the femur vertically, there were seen two well defined caseous foci of large size in the cancellated tissue, beneath the articular cartilage which was penetrated by both areas, so that the granulomatous tissue of their periphery projected into the cavity of the joint.

Microscopic exam. of the thickened membrane showed recent tubercular granulations; in the fibrous clots these were still better marked. (figured plate XIII page 27). The lesions in the femur were undoubtedly of older date than those in the membrane itself; their presence was unsuspected till the joint became infected.

The appearances of this membrane suggested rheumatoid arthritis or arthritis deformans; I would not have believed it tubercular until I saw sections of it under the microscope. (It is preserved in the University Museum and will repay inspection.)
Case III. Tubercular Synovitis merging into Arthritis.

Mrs. Gray, aged 42, admitted Ward 15, Dec. 1874. For some years she had suffered from "rheumatism" in her right knee. She had developed symptoms of loose bodies in the joint. Dr. Maclean incised the joint on both sides of the patella 19th, 19, 76. He then ascertained a turbid synovial fluid together with a large number of loose bodies, varying in size from a pea to a hazel nut, of irregular crumpled shape, firm and fibrous. The membrane was thickened, purplish and gelatinous.

The joint became septicaemic, rigor developed, with albuminuria, sweating and a purpuric rash on the thorax and abdomen. The knee joint was removed post mortem.

The loose bodies under the microscope showed nodules of hyaline cartilage and recent bone lying in a vascular connective tissue, they were evidently detached synovial fringes. The synovial membrane showed the ordinary histology of "gelatinous degeneration". In the head of the tibia there was a diffuse caseating tuberculous infiltration of the superficial cancelli with destruction of the trabeculae and articular cartilage, exposing on the articular surface a caseating granulation tissue embracing fragments of bone (caries of articular surface).
There can be no doubt that this bone lesion was at the root of the case although the symptoms throughout were arthritic & led to the diagnosis of rheumatic symptoms until loose bodies, up till the time the joint was noticed as described.

These three cases have been detailed at some length and under the heading of "synovitis" because they are so apt to be confused with those arising from other causes.* It has been shown that the arthritic & rheumatic varieties are those from which the tubercular is to be carefully distinguished. The diagnosis is to be based on the history or presence of tubercle elsewhere, the absence of inflammation or fever; the insidious development of the effusion and its subsidence under rest together with a tendency to rapid recurrence. The presence of foreign bodies and especially of thickening of the synovial membrane. It occurs between the ages of 16 & 40 when chronic rheumatic arthritis (arthritis deformans) for which it is most liable to be mistaken, is rare. The probable existence of tubercular foci in the bones is to be borne in mind & the tendency of the disease to progress & ultimately assume the familiar features of an ordinary tubercular arthritis.

*Macnamara - Dis. of Bones & Joints relates cases exactly corresponding to these in the text, but does not even hint at their tubercular nature.
Hönig advocates a radical arthrodesis in all cases of advanced hydrosp tuberculosis but as reemergence occurred in three out of ten cases one does not feel drawn to follow out his instructions. As I have already stated he omits all mention of the condition of the bones in his cases whereas I have shown that it is in these that the root of the affection is usually situated. The reason of the reemergence after operation is therefore not far to seek.

Type of joint-tubercle. Tubercular Arthritis

Syn. Strumous Arthritis, Tumor Albue, Gelatinous degeneration of the synovial membrane. German "die granulierend tuberculöse Gelenkentzündung" French "les ostéoarthrites tuberculouses de longueurs."

I have entered so fully into this omnipresent affection in the earlier portion of my paper while treating of its pathological anatomy that for the present I will defer discussing its clinical features until I describe the arthritis as it manifests itself in the special joints, for it presents such tremendous variations that anything in the way of a general description would not promote the object I have in view.
III. Type of joint tubercle - Suppurative tubercular peritonitis or cold abscess of joints -
"Ache's joint articulare" "Empyema articulotionis tuberculosum" "Pyarthrosis tuberculosus".

As a rare manifestation it takes the place of an acute suppurative (suppurative) arthritis resulting from tuberculosis. I have never seen it, but I have been struck with the hesitation on the part of operators in answering the question "Was there pus in the joint you opened yesterday?"

Severe pus in the interior of tubercular foci in the substance of the synovial membrane is not included in this type. Such pus is not in the joint cavity but outside it and has on the whole a greater tendency to rupture externally than into the synovial sac.

When the latter occurs diffuse tubercular suppuration may result.

Koening describes it as being "typically seen in diffuse milky tuberculosis of the synovial membrane, the latter being covered by a pyogenic or fibrinous layer. It is seen in the knee where there may be as much pus as there is fluid in a hydrops, very rapidly produced. In the hip it rapidly perforates the joint capsule and forms large abscesses in the periarticular tissues especially in children.

He regards this form as a primary injection of the
Synovial membrane rather than a result of secondary infection from bone forci. Clinically it is distinguished from acute joint suppuration from altar causes light absence of some peculiar phlegmon and the constance in most cases of multiple tubercle in other parts of the body, and consequent hectic. It rarely follows upon a hydrox.

Results of Joint-Tubercle

In question of there is any surgical disease in which one is more uncertain as to prognosis in any individual case than in the subject of our paper. A tubercular family history apparently exercises very little influence on the clinical course of the joint. I have before me the case of a girl aged 22, whose father, maternal uncle, aunt, & cousins, all died of pulmonary phthisis & who notwithstanding made an 'apparantly' good recovery from his disease after repeated aspiration of abscesses resulting therefrom. On the other hand a girl of 22 whose father, brother & sister died of phthisis, suffered from disease of this time for ten years & after division of the tibia, suppuration occurred and
hletic set-in. Similar opposite results are seen in cases belonging to healthy families. We must suppose in the case of easy recovery that the bacilli have as yet only a local lodgment, that their number is limited, and that the resulting deposit is of the dry kind tending to cicatrise & die. While the disease progresses indefinitely, the original dose of bacilli must be a large one, & probably repeated from time to time from some focus elsewhere in the body, so that the lesion or lesions are of the soft infiltrating kind, without barrier, no tendency to cicatrice, but rather to continuous destruction of their surroundings.

There is a general agreement among surgeons that tubercular arthritis is curable. Of this there can be no doubt. I have seen scores of old joint lesions in the dissecting-room post-mortem rooms, which have as certainly cured as the more frequent fibro-calcemous cicatrices in the apices of the lungs.

There must always remain however some doubt as to the completeness of the cure. The bacilli of tubercle have not as yet had any time limit applied to their tenure of infective power within the body; they dont wear themselves out after the fashion of other organisms, in which the struggle between the
issues. The virus terminates in the death of one or other. In tubercle the slumber may be great on both sides, and yet an armed neutrality persist; consisting of a fibrous capsule on the one side, enclosing a nest of bacilli or spores on the other; a weakening of the former or a reinforcement of the latter especially by septic organisms, results in a fresh outburst of hostilities.

Tubercular arthritis is common in youth, rare in age. It is a question whether sterile tubercle is not, in many cases, the fresh eruption of a lesion deposited in youth. I have seen a strong man of good family, history, this winter, with advanced arthritis of the elbow who had suffered in the same joint 30 years previously, at which time Mr. Spence opened an abscess over the olecranon.

When Healing does occur it is rarely perfect. The growth of the limb may be impaired on account of destruction or abolished function of the epiphyseal cartilage movement may be restricted by adhesions or ankylosis.

I have recently examined a knee joint in April of 17 after prolonged rest in plaster, apparent cure; the pulpy synovial membrane had shrunk to become fibrous constituting band-like adhesions between the true bones, with these were incorporated the detached
semilunar cartilage & crucial ligament while in certain
remaining portions of the synovial membrane there was a small
soft caseous focus partly encapsulated.

I show in plate XII the drawing of a section of a hip
described in the University Museum catalogue as
"osseous ankylosis of the hip from a dissecting-room
subject." Their sections of this specimen, after softening
the tissues revealed a different state of matters.

The femur is fixed in the acetabulum in the adducted
position; the union between the two is nowhere osseous,
at certain points, notably at the attachment of the ligamentum
teres, the opposing surfaces have grown together by fibrous
tissue but on their greater extent, the term opposition
would more correctly indicate the condition of affairs than
the term union for the surfaces are for the most part covered
by their articular cartilage. On the inner aspect
of the femoral head, there is an old tubercular focus, the
size of a pea containing necrosed trabeculae in a caseous
detritus & surrounded by fibrous tissue which shut off
the focus from the canals of the head of the bone on the
one hand & connects it to the articular surface of the
acetabulum on the other. In the vicinity of this area
there are several microscopic tubercular granulations in
the canals of the head. The spongy tissue of the femur
generally is much sclerosed while in the acetabulum


Then there microscopic evidences of old tubercular infiltration.

There can be no doubt that where fibrous ankylosis has occurred, especially in the young, that the movements tend to become fixed in the course of time through stretching of the adhesions. Even after considerable destruction of the articular surface, a new joint tends to form, or the meniscus, there is left, the more likely so this to occur. One sees very good joints after a very radical arthroectomy for instance.

Bony ankylosis

is rarely seen as a spontaneous result of tubercular arthritis at the present day; it usually follows an advance destruction of the articulating bones with suppuration, sinus etc.

In what may be in good or bad position, I show in plate XV a complete osseous ankylosis of the knee in a young subject (University, museum no 475); the leg is at right angles with the thigh, the leg is rotated out; the tibia greatly atrophied. Ossous ankylosis is more often seen in museums than in hospital but there lately seen in the infirmary an elbow ankylosed by bone in the position of complete extension, the result of tubercular arthritis fifteen years previously. It should be noted that "Arthritis deformans" (chronic rheumatic arthritis) never does ankylosis by bone because the joint is never kept at rest; in tubercle ankylosis is mainly to result, the joint being involuntarily maintained immobile.
In forming our prognosis in tubercular arthritis we must bear in mind that the life of the patient depends on more factors than his joint arthritis; these must not deter us from undertaking local operative measures.

A certain number of patients die of general tuberculosiis originating from the joint, while a much larger number die of tuberculosis elsewhere e.g. lungs, kidneys etc.

Billroth has established from 16 years' observation that 27% of all cases of tubercular joints die of tuberculosis (König). A very small number succumb to early degeneration of the viscera.
Tuberculosis of the individual joints

The shoulder: is chiefly remarkable for its rarity. During the last twelve years Mr. Dumeau has operated on 237 tubercular joints; of these there were only 6 shoulder cases. There are only two specimens in the university museum. This rarity is ascribed by Koenig to the circulation mechanism of the shoulder not being favourable to tubercular infection; for myself I do not see how its circulation differs from other joints; its freedom from tubercular infection may possibly be ascribed to the general laxity of its component parts enabling it to escape the jabs and concussions to which other joints are liable.

There would appear to be two clinical types of shoulder tuberculosis: one occurring in youth especially between the ages of 15-20 characterized by wide spread destruction of the humeral head & glenoid, together with synovial infection - the destruction of the humerus tends to involve the shaft more frequently than is the case in other joints. Abscesses form both in front & behind the shoulder & result in multiple sinuses if left alone. This form is always recognized as tubercular from the outset.
there is a second type occurring later in life; I have
seen it especially between 50-60. It is characterized
by a very insidious destruction of the articular portion
of the head of the humerus by a dry tubercular granulation
deposit; exactly what used to be called in this country
"infection of articular cartilage" by Volkmann "Canis sicca.
the glenoid & suprascapular membrane may be similarly
affected. Abscess formation is not so likely to occur in
late of development. Such cases may have a duration
of many years (as many as 8); they are apt to be
mistaken for rheumatic affections & even neuralgia
of the "head of the bone" as it is called. Occasionally the
diagnosis is not made until abscess formation;
weakening of the deltoid & scapular muscles should
raise suspicion when occurring early in the case.
Some recent writers (Vogt of Breslau) have even
thrown doubt on the tubercular nature of this affection
but the microscopic & experimental tests have
established this as certainly in the shoulder as
in other joints.
I have only had an opportunity of examining one
recent specimen, the details of which are briefly as follows:
A vigorous man of 56 admitted Ward 7 H.Q., Inf. June 88
of good family history; he had enlarged glands in the neck
as a boy, otherwise been healthy until he injured his
left shoulder by a fall 3 years ago; 5 months ago an acute pain at the anterior axillary fold and discharged ever since. Mr. Annandale seized the head of the humerus July 4th 88 and found the joint disorganised, the cartilage separated from both articular surfaces, the superficial bone granulating & disintegrated (Caries). The man bore with a useful arm.

Vertical sections of the humeral head removed by operation showed (1) three or more defined tubercular foci about the edge of a small tear, caseated & containing microscopic septa. (These were only seen after staining & mounting).

(2) scattered tubercular granulations throughout the entire head, especially seen around the blood vessels which were occupied by a granular debris. These granulation contained few giant cells & were caseated for the most part, eroding & breaking up into fragments the bone trabeculae in their vicinity.

(3) near the articular surface these granulations had become confluent & sprouted up beneath & separating the cartilage in a continuous layer. In the surface itself they had become coalesced & fibrous, probably allowed to do so by the continued rest in which the joint was maintained.

(4) The synovial membrane showed numerous tubercular granulations in an advanced stage of caseation.
The elbow is one of the joints most frequently affected and in a very typical fashion. Surgically it may be looked upon as one of the most favourable sites of tubercle from the point of view of successful eradication of the disease with safety to life and with recovery of a useful limb. Then the disease is usually limited to the neighbourhood of the joint and is removable by excision is shown by the fact that amputation subsequent to the latter is one of the least of events. The Duane for instance has a series of 41 excisions of the elbow with local recovery while out of 37 excisions of the wrist he had ultimately to amputate in 5 cases.

In principle tubercular arthritis of the elbow shows less variety than any other joint in the body and is consequently always recognized in the case. The cases of osseous origin largely predominate (42 such to 10 synovial König) and it is instructive to note that of the three component bones the radius is scarcely ever primarily infected; the ulna is the case in the wrist where the ulna usually escapes. This is what was to be expected from the function of these bones in the two joints. The ulna is the primary seat of the disease in
The elbow matters more frequently than is the lower end of the humerus. The rarity of radial infection explains the clinical fact that flexion & supination are long retained after flexion extension have become painful or abolished altogether.

The bone lesions are rarely of a gross nature, though such may occur. In the University Museum there is a specimen (390 a + 298) in which the olecranon has died in massæ (tubercular necrosis) & become partially separated from the ulna, lying in a cavity which opens on the skin posteriorly by several sinuses.

It is of frequent occurrence in the elbows that the bone form set ups periarticular abscess which bursts on the skin surface forms a sinus before penetrating the joint itself. The sinuses are usually on the postero lateral side on the lower end of the humerus or the radial side of the olecranon.

Fungating synovial tubercle is almost invariably present in advanced cases, of a purplish, semi-fluid gelatinous character, filling up every cranny of the joint & overlapping the edges of the articular cartilage. It cannot entirely com the latter as it does in the knee on account of the immediate contact of the bony surfaces.

The elbow, like the shoulder may be affected in
advanced years. I have seen it in a man aged 68. One never sees disease of the hip or knee at this time of life, does this mean what I have previously hinted that stifle joint tuberculosis is the result of deposit in youth? That joints with functions like the hip or knee do not permit of its lying dormant for years but rather favour its coming to a head as it were with the result that either the patient or the tubercle is mortised.

I will record two examples of elbow tuberculosis, one in the child, one in the adult.

1. Case. Delicate boy of 14 admitted Ward X., 11.1.87. Family history of insanity & deaths from chest disease. 9 weeks ago, elbow became spontaneously stiff, painful & swollen. When seen first an abscess had formed post. Mr. Duncan excised the joint 21.1.87. The patient was discharged healed & with movable joint 14.3.87. The synovial membrane was thickened & gelatinous overlapping the cartilage at their periphery; in the central area of the cartilage, small red granulations could be seen coming up through the latter from the bone, especially thin near recent tubercular granulations throughout the synovial membrane. In the ulcer shrunken, there was a layer of granulation tissue.
immediately beneath the articular cartilage, which in the case of the ulna was all but separated; further in the superficial cancelli were a few isolated avascular granulations. The radius was normal.

Case 5.

Strong healthy man aged 42 admitted 18th Jan. 79. Family history perfect. Elbow began to trouble him at the age of 13; Dr. Smith opened an abscess on the joint at this time; after this had healed he was practically well for many years, although stiff, and occasionally painful. Within the last few years, the attacks of pain and uselessness of the joint have lasted longer and been more frequent. Mr. Duncan excised the joint 18th Jan. 79. The soft tissues outside the joint were thickened and matted together. The remains of the original sinus led down to a caseous abscess on the posterior aspect outside the joint. Synovial membrane much swollen, in a state of pulpy softening, involving the capsule. There was a little dirty spongy, partly suppurating, tissue in the joint itself. The bones were firmly fused together by fibrous adhesions and granulations springing up from the humerus & sigmoid cavity through the remains of the articular cartilage.

Sections of the bones under the microscope showed sclerosis of the spongy framework together with a very...
fatty marrow - several large blood vessels running down towards the articular surfaces. The latter are occupied by a dense fibrous tissue, embracing the fragmentary remains of the articular cartilage and enclosing areas of yellow subcancellous tissue, which is continued at some points into the cancelli of the bone for some distance - eroding & breaking up the trabeculae.

A lot of the fibrous tissue runs at right angles to the articular surfaces, connecting the humerus & ulna.

These changes have doubtless been secondary to synovial overlapping & invasion of a very chronic form, the new tissue being probably vascularised from the subjacent bone.

The periphery of the articular surface of the radius was similarly destroyed.

---

**The Wrist.**

is frequently affected. The primary foci are in the bones as a rule although clinically the characteristic signs of wrist tubercle are produced by the synovial thickening, e.g. swelling on the dorsum of smooth & full outline obstructing the tendons producing prominence. Always a sinus is usually dorsal because it leads
To bone & the batten are nearer the skin on the dorsum.
In advanced cases in museums one may see tubercular
destruction ("caries") involving the radius & ulna, the
entire carpus & the proximal ends of the meta-carpus-
occasionally in such cases, the carpus - meta-carpal joint
may alone escape.
In a recent specimen I examined
the primary focus was in the bone end of the radius
in the shape of a caseous abscess, perforating the extensor
shell on the dorsum; the carpal bone looked perfectly
normal but on cutting through it I found
an old focus of large size in the os magnum & another
in the unciform.
When one bone is infected, the disease
spreads to the others through their synovial attachments
& doing so infects the synovial membrane itself.

I record one bad case of Wrist Tubercle as illustrating
the extent to which recurrence may go after operation.

Colin Cameron aged 27 admitted Ward X 7.7.86.
His right wrist became swollen & painful in November 85.
An admission was acutely inflamed. Mr. Duncan excised
the entire wrist 13.7.86; The wounds became septic later.
Three months later tubercle reappeared in the operation area
& was scraped with the syphon; this performance was
followed a month later by symptoms of sepsis
or more probably of tubercle dissemination.
Mr. Duncan amputated through the forearm on the 7.12.86 and the patient was sent to the Medical House at the end of January until developing putrid pulmonary.

Altogether an eventful and instructive history -

I made a series of transverse sections of the amputated member and submit a summary of the changes seen.

The first series of sections above the level of the previous excision showed an absence of tubercle with the exception of one or two circumscribed fibrous nodules in the loose cellular tissue between the bones; the radius & ulna themselves were enamelled with new periosteal bone otherwise normal; tendinities at different stages in the Radial, Ulnar, & their muscular branches.

The second series: at the level of the previous excision (see plate IV) almost the entire area of the section is infiltrated by a diffuse, caseated, tubercular granulation tissue, collected in the centre of the wrist into larger rounded masses, delineating surrounding tendons and nerves infiltrating & destroying the remains of the three muscles of the digits, at last reaching & penetrating the skin surface on the dorsum by means of two broad suppurating tracks or sinuses, probably in the situation of the original incisions in harvest operation.

Only two points are then any remains of the causal bones, a small rounded nodule in the centre of the section.
a few eroded tubularae in the wall of the radial sinus.

Remnants of prominent in the smaller branches.

The granulation tissue already alluded to is for the most part amorphous = caseated or superfluous, but one can recognize the remains of small round cells mixed up with abundant clotted fibrin. Amongst these are scattered tubular areas with abundant giant-cells. In the sinus there are numerous small blood vessels running upwards towards the skin surface, filled with yellow granular matter or red corpuscles. (Process of organisation attempted)

A third series of sections beyond the level of the previous excision, cutting across the proximal ends of the metacarpal bones. (See plate XV1)

The sinuses on the dorsum are superficial; the radial one abuts on the 2nd metacarpal = penetrates its outer compact shell. The ulnar sinus is between the 4th & 5th metacarpals both of which are similarly penetrated.

The second metacarpal shows a few tubular granulations in its interior & a penetrated crust of new bone on its dorsal surface.

The third has a large granulation area in the centre of its medulla, extending in its vessels & a penetrated crust of new bone externally.

Apart from the sinuses the concavity of the arch formed by the metacarpals is occupied by a superfluous granulation tissue.
surrounding the flexor tendons & median nerve etc. The tendons are invaded & infiltrated by the yellow tissue almost beyond recognition. Eosinophilic as before.

These sent in sections from which the drawings were made.

IV. Phalanges of Fingers - Strumous dactyilitis.

The familiar spindle shaped swelling is chiefly due to disease of the soft tissues but the primary lesion would appear to be located in the interior of the phalanges themselves. The routine treatment by rest or scraping prevents this fact being recognised. I record a typical case:

"In a chronic lunatic" aged 30, an inmate of the Cane Hill Asylum Surrey, the medical officer noticed for the first time a white swelling of the index finger in January 88. This finger was amputated in October 88. In plate XVII there is a drawing of a complete longitudinal medial section. One notices in the first place that the three phalanges have retained their normal shape and that the spindle-shaped enlargement of the finger is of pancreatic origin.

The interior of the 1st phalanx is occupied from proximal to distal end by confluent casorous tubercle, confined by the compact shell of the bone except at one point on the palmar aspect immediately behind the head of the phalanx where the casorous tissue has escaped externally, forced its
way beneath the flexor tendon to expand from a large solid caseous mass covering the distal third of the first phalange and prolonged onwards to the second which it perforates near the base, at the same time partially destroying the joint between the two.

On the dorsum of this first phalange are two large caseous masses breaking down in their centre. The extensor tendon separates the one from the other.

There is further in the second phalange, a series of isolated caseous nodules about the size of pin heads.

Small portions of the different parts above described were cut separately and examined with the microscope.

The lumen throughout was chronic with an extraordinary number of well formed giant cell systems. Very little distinction of the bony framework of the phalanges.

In the soft tissues the tissues showed advanced endarteritis and periarteritis. The capillaries in the marrow of the second phalange were much dilated and increased in number, approaching the structure of an angione.

Let any one inspect the drawing (Plate XIII) of this finger & consider the effect of scraping with the spoon the caseous masses on the dorsal aspect in the light of a radical operation!
The Hip— is at the same time one of the most frequent and most fatal sites of tuberculosis; it is rarely seen after the age of 25 although it occurs as late as 50; in about two-thirds of the inflammatory cases the patient is under 15. It often results in death because of the severity of the operations undertaken for its removal, because of the special tendency which it possesses to originate a general tuberculosis as already considered already because of the frequency of extensive abscess formation, sepsis, septicemia and watery-hectic exhaustion.

The primary deposit is in the bones in the great majority of cases; König and Volkmann give the acetabulum as the initial seat in half the total cases. I would go still further for in every case I have examined there has been extensive disease either in the acetabulum or in the femur—usually in both. There can be no doubt that in many of these the synovial membrane is simultaneously infected but this constitutes a very subsiding element in the disease as a whole, it scarcely shows itself clinically; it is not the cause of the destructive changes so prevalent in hip disease nor is it the focus of the general infection which not uncommonly results; this has been shown to occur from infiltrating tubercle in the acetabulum itself.
It may be stated generally that the gross lesions in the hip do not even manifest themselves on the articular surfaces of the bones even when the latter are exposed to view in an excision. In the acetabulum the primary foci are in the bone substance, usually at the margins of the Y cartilage, in the shape of a diffuse caseous infiltration or a large heterotopic sequestrum tending to extend to the pelvic aspect nearly as frequently as they involve the articular surface belonging to the hip. In advanced cases the destruction may extend further, perforate through into the pelvis involve the ischium even the pelvic rami. See Plate X

In the femur the gross lesions are in the majority of cases in the region of the epiphyseal plate of the head of the bone or its shaft aspect frequently coming to the surface of the anteroin aspect of the neck outside the joint, again one may have the epiphyseis of the great trochanter chiefly affected, either primarily or secondary to focus in the head which reach the surface of the bone by extending through the substance of the trochanter.

The acetabular disease may give rise to abscess directly within the pelvis or beneath the gluteus in the buttock or from the latter through the great iliaco-seatic muscle into the pelvis. The destruction of the rim of
The socket may permit of spontaneous dislocation of the head of the femur usually onto the dorsum ili. I am aware of the disregard of incomplete character of the above observations; but they must suffice me for the present. There follow certain illustrative cases:

Case I. A healthy boy of 13 admitted Ward xii. R.I. Dec. 1876 with a good family history; the disease commenced five months previously with "pneumatic fever," i.e., recovering from which the left thigh was flexed, fixed useless. On admission the limb was flexed rotated out, the joint tender to touch & movement, and there was an abscess in the front of the thigh which when opened was found to arise from a destroyed area of bone on the anterior aspect of the femoral neck outside the joint. Mr. Hume described the head beneath of the femur on the 12th. 1877; the extermal tissues were gelatinous, the articular surface normal; the femoral fovea was found in the head of the femur as shown in the plate XXXX opposite: on the shaft side of the epiphysical plate are several tubercular areas in the substance of the spongy bone, rounded, about the size of a pea or smaller, excavating & breaking down in the center; the larger of these has destroyed & perforated the epiphysical cartilage about its center & extended into the head itself.
If the sections be examined from which the drawing is made these foci will be seen to correspond with the distribution of large arteries which penetrate the neck of the bone in this region. The abscess already referred to in the front of the thigh had originated from these foci involving the compact bone on the anterior aspect of the cervix.

In the trochanters for this case there were recent scattered purulent granulations in its cancelli.

Such is a fairly typical example of hip joint disease originating in the substance of the femur.

The following case illustrates the part played by the acetabulum.

Case II. Mr. D., aged 44, admitted to Chalmers Hospital April 1887 with hip joint disease of 4 months duration; while in hospital a large gluteal abscess developed & was opened in May; it did not communicate with the joint. In June he died of Tubercular meningitis. The joint was excised post mortem—(nothing further allowed.)

Sections were made in the vertical transverse plane:
(1) of the acetabulum: in the substance of the latter
on both sides of the Y cartilage there was a diffuse caseating infiltration chiefly involving the articular surface destroying the cartilage tissue, but also extending to the pelvic aspect in a continuous yellow infiltration. The bone trabeculae embraced by
The Knee.

has superseded the clinical ideal of white swelling before the time was applied in its wider signification. The spindle shape of the limb with the white tumour in its middle is alone very thing characteristic. At the same time one must bear in mind that in the knee one meets with the less typical though rare manifestations of tubercle, almost to the exclusion of other joints; I refer to what has already been fully described when treating of tubercular synovitis, myositis, loose bodies or fibrous formations generally. The large size and superficial relationships of the knee render an exact diagnosis of the anatomy of any pain
case of tubercular arthritis more attainable than is possible in other joints. It is in some that one is sometimes in a position to discern the tuum arthritis and say that is a case of tuberculous of the femur or of the tibia as the case may be. In examining some cases I must again refer to the erroneous impressions acquired by looking at the joint. The latter often appears much enlarged, when it is nothing of the kind; because of the atrophy of the fat and muscle of both thigh and calf. Careful measurement with inchoate calipers is most instructive, using the sound bone as a standard.

The importance which has in the past been accorded to the synovial element in joint-tubercle is to be largely ascribed to the fact that the majority of original workers selected the knee for investigation. Synovial tubercle reaches its acme of development and destructive form in this joint.

I am convinced that if I had confined myself to the knee I should have acquired an erroneous conception of the relative importance of the bone factor and the synovial factor in tubercular arthritis.

The primary focus was ascertained in 69 out of König's 118 cases.
I have had more difficulty in recognizing the primary lesion in the knee than in any other joint for in operation cases the complete apparatus of the articulation is usually infected.

It is easy matter to see how a joint as I show in the plate opposite, drawn from a specimen in the University museum, is the joint of a young subject musically bisected showing two large fori in the upper end of the tibia, one of which has penetrated the joint and caused arthritis, the articular has involved the compact shell of the bone anteriorly.

Primary tubercle would appear to be equally common in the femur and in the tibia. The tibial is the former more commonly infected but it is frequently invaded by synovial granulations on its articular aspect. The superior tibio-fibular articulation is scarcely ever involved; as might have been expected from the nature of its function.

Small chronic abscesses are frequently present in the substance of the tibial synovial membrane but pus in the joint cavity itself is very rare.

Abscesses outside the joint are frequently met with, their usual sites are the ham from which may extend downwards into the calf, and the aorta in surface of the thigh beneath the quadriceps.
The following is an example of knee tubercle of osseous origin.

Case I. Healthy looking man aged 21 admitted W. and 13. B. I. Nov. 22nd 87. The younger brother died at 17 of diabetes & phthisis. Patient had suppurring glands in the neck 4 years ago with permanent scars. Shortly after he recovered from these he was thrown out of a cart & fell on his right knee; he walked about the same day & during the subsequent 2 months. Gradually however the joint became stiff & painful & he lay up for 6 months. Thereafter he began to go about again, at first with the aid of crutches, but was able to resume his work as a plumber. A year ago an abscess formed painlessly & burst of itself leaving a sinus which has repeatedly healed & re-opened, while the joint itself has become absolutely rigid in the semi-flexed position.

Mr Chirne amputated through the lower third of thigh 5. 12. 87: the joint was frozen & sawn in vertical sections.

The cavity of the joint was obliterated and the bones firmly encroached together by fibrous tissue. The synovial recess alone the patella contained a few scattered tubercular foci seen with microscope. The infrapatellar pad consisted of normal fat. The fibrous tissue uniting the femur & tibia consisted in a layer of dense fibres covering each bone, while between the two layers there was some compressed caseated granulation tissue with giant cells. The remains
of old synovial tuberculosis. In one of the series of sections there was a large tubercular focus in the femur and in the tibia (see plate XXII) close to the articular surface in each case. That in the head of the tibia is circular, well-defined and surrounded by sequestered bone.

The relation of these foci to the joint was shown in another series of sections further from the bursal plane; the focus in the femur extended downwards and to the side, involving the articular surface, destroyed the cartilage and infected the joint itself. Microscopically both foci consisted of contiguous areas of chronic caseous tubercle with giant-cells.

These appearances explain the unusual clinical history of this case and exactly correspond with the sequence of events thus detailed.

The next is a synovial case.

II. Little girl of 10 admitted Ward III R. Inf. in May 1888.

Her father laboured under chest weakness and a sister died of bronchitis in infancy. The patient was healthy until 3 years ago when she got her left knee "hurt".

In Annandale amputated through the lower third of the thigh on the 23rd May and she was dismissed cured on the 12th June.

The joint was flexed at an acute angle and exhibited the usual features of white swelling with doughy synovial membrane. The interior of the knee was disorganised.
The articular surfaces of the femur & tibia were covered for the most part by synovial tissue common to both, half an inch in thickness. On raising the membrane from the bones the cartilage was found to have disappeared. Over the base in half of the external condyle of the femur the surface bone was eroded & disintegrating (caries); the corresponding area of the outer facet of the tibia was in a similar condition. There was no fluid in the joint.

With the synovial tissue were incorporated beyond recognition, the semilunar discs & the cruciate ligaments.

In the substance of this tissue were several minute points of calcifying tubercle but for the most part it consisted of a toughish gelatinous tissue of a greyish white colour continuous with the thickened synovial membrane lining the capsule of the joint. The articular surface of the patella was covered by a layer of infected granulation tissue in which one could recognize a number of small, worm-eaten cells of articular cartilage.

The femur & tibia when cut in vertical slices showed no lesion of their spongy substance; there was some vascular injection beneath the epiphyseal plate but the disease was confined to the immediate vicinity of the articular surfaces.

Sections of the articular surface of the femoral condyles showed the following changes under the microscope:
The bone of the trochea or overlapping synovial fungus are in immediate contact, the cartilage between the two being partly eaten up, partly detached and incorporated with the synovial tissue. The surface bone presents an irregular line of eroded trabeculae with invasion of the superficial cancelli with cellular processes from the synovial tissue.

As the centre of the trochea bone is a larger, defined, trabecular area the size of a small pea, included within the bone but derived from, and continuous with, the overlapping synovial tissue. The spongy tissue has attempted to has so far succeeded in limiting the invasion by forming a barrier of new trabeculae around this particular area. The latter is of caseous structure enclosing in its centre a number of eroded or dead trabeculae. In the deeper cancelli are several small, isolated, recent yellow granulations.

Sections of the tibia showed similar changes in the articular surface; at the posterior extremity of the articular facet, the synovial invasion had penetrated the bone substance for 3 mm in a vertical direction, almost reaching the epiphyseal cartilage.

The patella presented a similar destruction of its articular surface.

The Synovial Tissue showed characteristic trabecular areas, endoartities, inflammatory new tissue, fibro etc.
The Ankle and Tarsus

When we speak of the wrist joint in relation to disease or operation we include everything from the bone end of radius & ulna to the proximal ends of the metacarpals; I hold that it would be an advantage to regard the corresponding bones & joints in the lower extremity from the same standpoint, more especially in dealing with their tubercular affections.

With regard to the distribution of tubercles in the ankle & foot & the initial site of the lesion, I am unable to furnish statistical information; the primary foci appear to lie in the bones in most cases although along with these there is usually considerable amount of synovial tubercles especially in the case of the ankle joint proper.

Small foci are met with in both malleoli but may affect not only the ankle, but the inferior tibio-fibular articulation. Large circumscribed abscesses (Brodie) are met with in the bone end of the tibia also in children one may find a large wedge sequestrum in the diaphysis, extending into the epiphysis then projecting into the ankle joint. (Kööng) The neck of the astragalus is a frequent site of tubercle; from there the ankle joint, alone,
may be injected at the synovial attachment to the astragalus; in front the astragalo-scaphoid and below the calcaneo-
astragaloid joints are liable to be simultaneously
injected from the original focus.

Fori in the os calcis may inject the astragalus and
through the latter, the ankle joint or quite as likely
spread to the cuboid in front.

A frequent clinical combination is as follows: osseous
fori in one or more of the tarsal bones together with
synovial tubercle of ankle.

Sequestrum are frequent in the spongy substance of
the astragalus and calcis; in the latter, one often
sees the base of a wedge-like sequestrum on its
origin aspect.

Apart altogether from definite tubercular lesions,
one frequently is able in the case of the tarsal bones
to strip off with the finger nail the entire periosteal
and cartilaginous investment of the bone, exposing the
spongy tissue which looks raffinated and an intense
red colour. This is analogous to the familiar
observation in the ends of the long bones where one
easily strips the articular cartilage with the finger
nail in tubercular cases; this latter condition has
been described in the preceding page as the result
of a sub-chondralritis (see ante). I am not certain
that the same explanation will hold in the case of
the talar bones.

There is another accompaniment of tuberculosis in the
foot viz: an extraordinary rarefaction & fatty
transformation of the trabeculae & marrow respectively;
the latter may be almost fluid or jelly like, the
bone cuts with a tender & crumbling under the finger.
When such a bone is evacuated, there only remains
the most delicate framework imaginable of the
bony tissue. It is specially seen in the tarsus & metatarsus
& seems indifferent in the young or in the aged.
I will not venture to account for this appearance but
emphasize the fact that it is not a direct result of
tubercular infection.

I should have liked to have accumulated sufficient
with regard to
data of the distribution of tubercle in the tarsus &
metatarsus as arguments against partial
amputations of the foot (Chepart, Fly etc) for "stumps"
in the light of radical operations but have not at
present had the opportunity of so doing. Further,
I should have liked on similar grounds to condemn
evisceration of the ankle joint.

I will record two illustrative cases of
Tuberculosis of the foot, the one in a child of
3, the second in a man of 47.
Case I

R.S. a little girl aged 3, admitted to the St. John Children's Hospital 25.10.88; the disease commenced spontaneously in the right foot a year ago; an abscess was opened on the dorsum of the ankle in July 88. Mr Bell amputated by Syme's method on the 25th October 88.

Sections of the lower end of the Tibia & Fibula showed the articular surfaces to be covered by a well defined thick layer of granulation tissue, continuous with, a divided from, the thickened synovial membrane at the periosteum & with a similar gran. Tissue passing upwards between the two bones. (see plate XXII) This consisted of "ordinary" granulation tissue with abundant new blood vessels. The articular cartilage of the tibia has entirely disappeared, while a few fragments of that belonging to the fibula are embedded in the gran. tissue covering it. There is very slight invasion of the cancelli but the marrow tissue is very vascular with extensive small celled infiltration around the vessels. The epiphyseal plate is fulfilling its normal functions.

The Astagalus is shown in two different autopsic sections. Its upper surface is deeply excavated so as to form a cup lined by a caseating granulation tissue, seen with the microscope to be invading the remaining bone and then reaching the superior aspect where it rests on the os calcis. This tissue is continuous with the synovial membrane of the ankle, the latter forming prominent ridges at the margins.
of the cup. In the articular section of the astragalus, an earlier stage of this synovial invasion + destruction is seen (plate XXII) The convex articular surface for the scaphoid is normal except slight periarticular overlapping of the cartilage by the synovial membrane. Its attachments to the os calcis sufficiently are permeated by a evescating granulation tissue.

I believe that these destructive changes in the astragalus are secondary to synovial tubercle.

In the synovial tissue throughout, the usual granulocyte areas + dendrites are characteristic.

Complete antero-posterior sections were made of the os calcis + cuboid together; under the microscope, the superior attachment of the former contained tubercle follicles. Congenital granuloma cells with commencing invasion of the superficial cancelli. The marrow thin but very fatty. The synovial membrane of the calcaneo-cuboid joint was free from tubercle. The cuboid itself healthy.

Complete sections of the scaphoid, inferior cuneiform + of metatarsal + of the other bones showed entire absence of tubercle.

II. Case J. M. aged 47. Admitted Ward X F.I. 15.10.77.

a feeble man with commencing pulmonary phthisis. The disease began in the internal cuneiform, Six
months ago; his doctor in the country scraped this bone eh. away. After a temporary improvement the disease recurred. The wound was septic from the outset.

Soon after admission Dr. Duncan removed the foot by Symes amputation. Patient died 5 days later, with combination of phthisis and pneumonic - 2 o'forn.

Articular joint healthy.

Astragalus: articular surfaces normal; commencing tubercular destruction of superior aspect of the neck of the bone not involving the article. Os calcis - manœuvre felt.

Cuboid: a rounded caseous mass in its interior the size of a pea, quite isolated & distinct. The dorsal & plantar aspects of the bone partially destroyed by a caseous suppurating tissue belonging to a diffuse abscess on the dorsum of the foot. eh.

The middle & external cuneiforms & seaphoid in an advanced condition of caries & healed in pus, which discharged by a sinus on the dorsum.

The proximal end of the first metatarsal simular destroyed eh.

There was a separate (unexpected) cheesy abscess at the base of the great toe, implicating the metatarsal phalangeal joint.

The articular of the first phalanx of the great toe was
filled with cheesy tubercular tissue throughout - 
"ostomyelitis tuberculosa suppurativa".

The appearances described in this specimen should make one very guarded in hazarding an opinion on the probable extent or number of diseased foci in cases of foot tuberculosis.

VIII. Metatarsus + phalanges

are affected in exactly the same manner as the corresponding bones in the hand; their deeper situation however makes their recognition a more difficult matter before abscess + sinus reveal the nature of the disease.
References

To recent literature on Tubercules of Bones & Joints.


De la Tuberculose Chirurgicale - Chavot. Revue de Chir. 74


Contributions à l'étude des Tumeurs Blanches et des Absces froids dans leur rapport avec l'injection tuberculose - Menard. These de Paris 1874.


Transactions Medical Congress Copenhagen 1874.