

5-1-1934

## Tuberculosis of the spine or pott's disease

William P. Warner  
*University of Nebraska Medical Center*

This manuscript is historical in nature and may not reflect current medical research and practice. Search [PubMed](#) for current research.

Follow this and additional works at: <https://digitalcommons.unmc.edu/mdtheses>



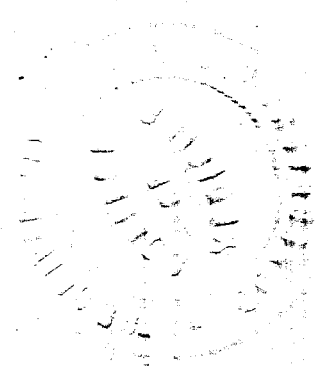
Part of the [Medical Education Commons](#)

---

### Recommended Citation

Warner, William P., "Tuberculosis of the spine or pott's disease" (1934). *MD Theses*. 628.  
<https://digitalcommons.unmc.edu/mdtheses/628>

This Thesis is brought to you for free and open access by the Special Collections at DigitalCommons@UNMC. It has been accepted for inclusion in MD Theses by an authorized administrator of DigitalCommons@UNMC. For more information, please contact [digitalcommons@unmc.edu](mailto:digitalcommons@unmc.edu).



Tuberculosis Of  
The Spine  
or  
Pott's Disease

Senior Thesis  
April 1934

William P. Warner Jr.

INTRODUCTION

PATHOLOGY AND MORBID ANATOMY

AETIOLOGY

CLINICAL FEATURES AND SYMPTOMS

DIAGNOSIS

TREATMENT

COMPLICATIONS AND THEIR TREATMENT

PROGNOSIS

SUMMARY

BIBLIOGRAPHY

480623

## INTRODUCTION

It is not the object of this paper to give a complete resume of the known writings on the subject of tuberculosis of the spine. Due to the extensiveness of the work that has been done here, such an attempt would indeed be ill-advised. It is my purpose to set forth an understandable concept of the mechanism of the disease, along with the modern concept of the diagnosis and treatment as practiced today.

The name of Pott's disease, as applied to this condition is not new. On the contrary it was used before the etiology of the condition was known. Sir Percival Pott of London (#0) gave an accurate description of the gross lesions in a work entitled "Remarks on that kind of palsy affecting the lower limbs, in curvature of the spine", which was written in the year 1779. It is evident from the title of his work that the tuberculous nature of the disease was not known, as we understand it today, but the picture we derive of the condition he was describing, is that of the later stages, and complications of the disease. However, this is not the first instance we have in history of some knowledge of the disease. As early as 738 B.C. Galen and Hippocrates, in their records, had spoken of "tubercle within and

without the lungs". In 1590 Ambrose Pare wrote of such a condition, and treated it by the means of a brass cuirass. Thus is it shown to us that here was a problem present long ago, and that the physicians of that time were not unaware of its existence, and that, in some cases at least, they took active steps toward its treatment.

Indications of the existence of the condition in the prehistoric American are given by a specimen of an Indian skeleton, which is exhibited in the Peabody Museum, at Cambridge Massachusetts. (30)

Work upon the determination of the etiology of the disease, as it has become our understanding today, came after the isolation of the tubercle bacillus by Koch, and the concept of its vital relation with tuberculosis, but progress was rapid, and even late in the nineteenth century, and early in the twentieth, an understanding of this phase of the condition was held, and has not changed perceptibly to the present time (30).

It is for the reason, then, that knowledge of tuberculosis of the spine is great and writings extensive, that a paper of this nature cannot be more than the result of a sorting of all this literature.

For the fundamental points which I wish to make use of, I have referred to several textbooks (see bibliography), and for further elaboration upon these fundamentals, and the newer developments in the diagnostic methods, especially, and treatment, I have used the journals on the various branches of the practice of medicine.

## PATHOLOGY AND MORBID ANATOMY

"Pott's disease is a pathological process of tuberculous origin; which attacks the bodies of one or more adjacent vertebrae".(30) It is at times referred to by other names, examples of which are: "Tuberculous osteitis of the vertebrae", "spondylitis", "kyphosis", "vertebral caries". There are others but these named are used most commonly, as is illustrated in a survey of various works.

"It is a chronic destructive osteitis, due to the invasion by the tubercle bacillus of the bodies of the vertebrae which form the anterior, or weight-bearing, portion of the spinal column. This destructive osteitis leads to the formation of a knuckle on the spine, or an angular projection backward at the site of the disease. It is often accompanied by pain and paraplegia." (26)

Babcock (5) has classified the varieties of the disease as follows: (a) Central or osteomyelitic form, which occurs in childhood, begins near the thin epiphysis and the anterior part of the vertebral body is softened. Caseation and liquefaction spread to the adjacent intervertebral disks, and may involve contiguous vertebrae. the softened carious vertebral bodies, in their anterior portions are compressed and crushed, producing kyphosis. (b) Periosteal type, this is the usual adult form

form and "starts under the anterior longitudinal ligament, and spreads under it from body to body, possibly affecting a number of vertebrae and, although it usually does not produce a sharp angle or gibbus, does show a slight kyphotic bending. Pus accumulates under the periosteum and anterior longitudinal ligaments, and large abscesses may form, which spread, in the lumbar region, along the iliopsoas muscle to the ilium and thigh with the formation of a psoas abscess. Rarely the medulla spinalis is compressed by the pus or sequestrum.

Another such classification is essentially the same (3), with the exception that the authors give in addition, an intervertebral articular type. They state that the infection takes place through the epiphyseal arteries, which are branches of the posterior spinal, and which supply the posterior articular margins of the vertebrae. "In this type (3) the infection begins along the articular margins of the bodies of the vertebrae and consequently there is early involvement and destruction of the intervertebral articular surfaces. Abscess is also commonly found early in the course of the disease.

"As the disease progresses (3) there is gradual excavation from the articular surface toward the central portion of the body. Destruction may also extend to the anterior portion of the vertebra and when this point is



reached we see collapse of the body, as in the central type. Collapse, however, is rare in this type of the disease. External deformity is rare in healed cases of this type."

Doub and Badgley, the authors who give this classification, base it upon the different blood supplies. The central type, corresponding with that of the same name in Babcock's, arises from infection through the branches of the posterior spinal artery. It eventually results in destruction of the disk, as well as in the articular type where this process is thought to precede the others.

The anterior type given by Doub and Badgley, and corresponding to the periosteal type of Babcock's, arises by infection through the interostal arteries, and entering through the anterior longitudinal ligament.

Taylor gives a description of the pathology in some detail, but the essentials of which are as follows (30). Starting in an area of lowered vitality, and due to irritation of the tubercle bacillus, usually in the anterior spongy portions of the vertebral bodies, we have a small spot of hyperemia, of gray or grayish-red granulations, containing the characteristic gray or yellow tubercles, of one or more giant cells. Massed around them are epithelioid cells, and around these, lymphoid cells. Scattered through the tubercle are bacilli, possibly within

the giant cells but usually between them and the lymphoidals. The infection comes to the bones by way of the blood or lymphatics, or through contiguity with other tuberculous tissue. This area becomes larger and redder, the center becoming opaque and grayish with a zone of hyperemia around it. This caseation produced possibly by massing of cells around the tubercle, and the toxins of the bacteria, causing fatty and cheesy degeneration of the tubercle, and necrosis, in its central part. Lacunar resorption of bone always takes place at the seat of tuberculous granulations and the bone trabeculae become necrotic. If the process is rapid, the caseous node thus formed contains these necrotic trabeculae, which by a slow process are entirely absorbed. Once the area of granulation tissue is started, it spreads rapidly through peripheral extension. During the later and reparative stages, this area becomes less vascular and is converted into dense fibrous tissue.

The grayish area grows larger and becomes yellowish in color. As the result of this, three different conditions are possible. (a) Caries sicca, or caseation, which is a simple process in small nodes which advance slowly. (b) Caries necrotica, or caseation with suppuration, and liquefaction into tuberculous pus to form "cold abscesses", in which swelling is the only inflam-

matory sign that is present. Abscesses are formed of broken down bone tissue and tubercles, and may: point in any of various directions, discharge, and form sinuses, or they may form masses of caseous or purulent material which are encapsulated by surrounding fibrinous and inflammatory material, and then absorbed or calcified.

With either caries sicca or caries necrotica, we may have extension of the process by blending with other such areas or by actual extension of the original process through multiplication of bacteria and peripheral bone rarefaction and infection. Thus the putty or cheese-like areas found in hard bone, constituting tuberculous bone abscesses, and thus the name "tuberculous osteitis of the vertebrae. Liquefaction gives a cloaca or cavity, or "cavernous excavation" in the bone. In the osseous detritus are gritty remains of the necrotic trabeculae, or even splinter-like fragments, almost sequestrae.

The transverse and spinous processes are very rarely involved, since they are covered with hard bone, while the bodies are spongy. As the disease extends to the periphery of one body, the intervertebral disks, and contiguous surfaces of adjacent vertebrae are involved in the process. Where the disease is of any extent the intervertebral cartilages are absorbed only at the point of the disease. It is not, primarily, an articular disease.

Superficial osteitis, with no bone destruction and deformity, is very rare in its occurrence.

Since the localization of the disease process is in the anterior portions, it is obvious that with the destruction, there would be a tendency toward the collapse of the bodies, and telescoping of the vertebrae into one another. "As the anterior portions tend to telescope, the posterior portions must spread, since they are moving in an opposite direction against the fulcrum, which is represented by the nucleus pulposus. The intervertebral articulations are not the center of motion; this is impossible, mechanically because it does not correspond with the planes of motion of these articulations, and biologically because no joint could withstand such stress." (28)

"In certain cases (30) pus formation may be characteristic, which is usually indicative of extensive disease, or a very active process. It may also be the result of a secondary infection with pyogenic organisms. The pus naturally gravitates downward, hence the frequency of psoas abscess in lower spinal lesions. The abscess may also point, dependent upon the location of the original process and the lines of least resistance of course, postpharyngeally, in the neck, back, axilla, lung abdomen or groin. An abscess within the bone is usually

primary, while one without the bone is usually secondary or consecutive. The primary, in healing, may be absorbed and the secondary as well, but usually the latter ruptures, either:- (a) outward, to the body surface, or (b) into some internal part, forming a fistulous tract or sinus. Granulation tissue may project from the mouth of the sinus.

"Double lesions are not uncommon, particularly in patients with an active pulmonary lesion" (6).

The morbid anatomy of the condition varies, dependent upon the region of the spine involved, the extent and duration of the disease, according to Taylor (30).

1. When the disease is in the cervical region the neck appears to be shortened, or is actually so, and the chin is elevated. It is an unconscious effort on the part of the patient, as well as the direct result of the pathology, to do as much to relieve the stress and strain on the part as is possible.

2. In the dorsal region, the shape and capacity of the chest may be altered - a gradual but marked process in untreated cases. With the softening of the bodies, the weight of the head and shoulders pressing downward from above causes the telescoping of the anterior portions of the vertebrae, as mentioned earlier, and the separating of the posterior portions results in a backward

projection of the spinous processes, until two sound vertebrae resist further extension. It is thus that the gibbus, or kyphosis is formed. From this arrest, the fibrous or bony ankylosis which is attempted by Nature, is a slow process indeed. In very extensive cases even the direction of the ribs is altered, the capacity of the thorax diminished and compensation attempted by the bowing outward of the sternum. It is probable that there are very few of us who cannot remember seeing, at some time or another, such a deformity. With reference to Pott's disease in this area, we must keep in mind that Capener (6) says "the influence of the respiratory movements in exaggerating the disease in the dorsal region is noted". Here then, is one of the most important factors in the alteration of the chest shape, with tuberculosis of the dorsal spine.

3.. In the lumbar region, tuberculosis gives the patient the appearance of being short-waisted and sway-backed. The difference in motility in this part of the spine and the dorsal is seen as the reason for the marked difference in the morbid anatomy.

In severe cases(30) of lumbar Pott's disease, with this compression of the length of the spinal column, there may even be flexion of the aorta, with possible stenosis and resultant cardiac hypertrophy and valvular

This may go on to mitral incompetency and myocardial degeneration.

As to the localization of the disease, in these different areas of the spine, it is seen by the majority of the writers, that it is most commonly found in the dorsal and dorsolumbar regions; this is to be explained by these facts: (a) that it is the most exposed to injury; (b) that it is normally convex posteriorly, and thus conducive to kyphos formation, as against the concave, posteriorly, contours of the cervical and lumbar spines; (c) that the center of gravity of the body passes through the cervical and lumbar spines, but goes anterior to the dorsal; (d) that the attachments of the ribs transmit breathing movements, and others, to inflict additional trauma on adjacent diseased foci. The lumbar spine is second in frequency of involvement by tuberculous processes, while the cervical comes third, I saw only one case recorded in the literature, where the involvement was sacral in location.

Some figures as to the relative frequency with which the different areas are involved can be derived from Taylor (30) who gives dorsal involvement as 50%, lumbar as 35%, and cervical as 15%. A series reported by Doub and Badgley (8) gives the following results: cerv-

ical, only 1.8%; dorsal and dorsolumbar, 56.8%; and lumbar, 41.3%. I need not give more figures here, because in all of the comparisons I saw, the results very closely resembled these.

The natural process of repair in tuberculosis of the spine is, briefly, as follows: in the early stages, not especially extensive, by encapsulation and cicatrization usually. In later stages it is usually by ankylosis of the bodies of the vertebrae, accompanied by extreme deformity, as seen in untreated cases; this is a very slow process. In these cases there is probably a formation of granulation tissue, which heals, becoming less vascular and densely fibrous; a formative osteitis may occur around the transverse and articular processes, in this manner of recovery. (30) (5).



## AETIOLOGY

Tuberculosis of the spine is of more common occurrence than tuberculosis of any of the other joints. About 42% of all bone tuberculosis is spinal as to location. (30) (26) (35).

Age. Tuberculosis of the spinal column may appear at any age during childhood and is not uncommonly seen in adults. However, it is most commonly seen in children, before or up to the age of puberty. The opinions of various authors differ somewhat as to exact age limits, as can be easily understood, but it is in regard to all of these opinions that one can say, safely, that the greatest percentage of cases is to be found in children ranging from three to fourteen or fifteen years of age. It is not out of the way to assume that a great many cases reported in older individuals had been present for a long period, even from childhood, as an incipient thing, and it remained for some trauma, or even acute exanthema, to lower resistance sufficiently to account for the manifestation of the symptoms, and lead to diagnosis of the condition. (5) (30) (26) (35).

Sex. Sex plays no apparent role in the aetiology of Pott's disease. From a number of reported series, there showed only a very slight preponderance of its occurrence, in males. This was slight however, and if to be considered of any importance, it would perhaps point to

the slightly greater activity, with resultant exposure to injury and decrease of resistance, on the part of the male. This difference of activity, however, between sexes, is so slight in the ages where Pott's disease is most commonly seen, that very little importance, probably, can be attached to such a theory.

Predisposing. Predisposing factors have been classified in various manners. Taylor, (30), gives as the first thing - "pressure and position - the erect attitude increases the superincumbent weight, further irritating any trauma and disease foci in the vertebrae. The disease has not been reported in quadrupeds, and this is perhaps a penalty man pays for walking erect." Other factors, as can be outlined would be for the most part included under the head of lowered resistance or vitality. A predisposition may be inherited or acquired, and although the family history shows tuberculosis in perhaps 25% of the cases (35), in a larger number "the family history is as indefinite as in a similar class of patients under treatment for any other disease." Acquired predisposition then is the more important of the two, and includes such things as: injuries (falls, blows, etc.), which result in favorable conditions for the growth of bacteria through circulatory stasis and their lodgement in susceptible areas; "improper food;

improper hygienic surroundings, and the more constant exposure to tuberculous infection thus implied". (35). Latent tuberculosis, in the glands, which is seen in a great many cases, but is so often inactive, must be considered as a factor in the predisposition to Pott's disease. Local predisposition includes the injuries as mentioned above, as well as the known vulnerability of growing bone, accounting for the relative frequency of it's occurrence in childhood.

Exciting Cause. The invasion of the vertebrae by the Bacillus tuberculosis, transmitted to them from a previously present focus in some other location. Although most authors agree that this transmission is by the blood stream, the possibility of lymphatic transmission cannot be altogether disregarded.

## CLINICAL FEATURES AND SYMPTOMS

In referring to the symptoms and clinical features of Pott's disease we must keep in mind that in most cases, when the patient consults a doctor, the disease is not in its earliest stages. The onset is so insidious that many times the earliest symptoms are not noted, by the patient himself or by the parents, as anything more than transitory or as anything to cause any particular worry. D. J. Glissan sums up that situation by saying, (14)" The average human is not a profound or even accurate observer. Many symptoms which might bear relation to the initiation in the individual of a tuberculous process may escape his attention, or, being noticed, may be explained away on some hypothesis which however erroneous, satisfies him, and, further, he is liable to forget them when his attention is distracted by the onset of some such dramatic sign as pain or deformity." Thus is set forth the difficulty that is so often experienced in ascertaining when a symptom picture first originated.

The classical symptoms as given by Babcock (5) are as follows: (a) Pain in the back - at the site of the disease - dull - and increased by jars or by pressure on the head. (b) Referred neurologic pains, from pressure on rami, as intercostal neuralgia, abdominal "girdle pain",

"stomach ache." (c) Muscular rigidity and tension of the spinal muscles, shown by limited dorsiflexion and lateral flexion of the spine. (d) Spinal weakness. The patient may support the head by the hands, or the body upon the arms. (e) Deformity (kyphosis) - backward curve develops from the periosteal, or anterior type, and a backward angle, or gibbosity from the central or osteomyelitic form, above and below the point of the disease.

Pain in the back. This is probably the most constant feature, clinically, of all. Glissan (14) reports it as the earliest symptom in 51 out of 88 cases, both children and adults. It may, of course, be difficult to ascertain in very young children who are incapable of expressing their thoughts, but is very often recognizable, nevertheless, in such cases by such signs as: apparent ease in tiring, aversion for walking and standing, desire to be held in parent's lap and to be carried, guarded movements in walking and a stiff-backed so-called "military" gait. (26). Downes adds to this concept however (9), their supporting of the chin on the hands. He further states that his studies showed this symptom in 70% of the cases in his series, and that in those cases not exhibiting it, the onset might be indicated by only a general falling off

in spirits and activity.

**Referred Pain.** This symptom, as stated above is due to pressure on the rami, as from displacement of the vertebra or pressure from an abscess mass. It may be intercostal, abdominal, or even femoral (9), in which careful, detailed examination of the spine is indicated. This is not such a commonly observed feature, though, as the pain described above. Glissan reports it, (14) in only 9 of the 88 cases, even in association with the other symptoms, as local pain, rigidity, deformity etc.

**Muscular Rigidity, and tension of the spinal muscles.** This is perhaps first noted in the patient's inability, or rather a restriction in his ability, to move the head (26), as when the cervical region is affected. The restriction is greater in forward and backward bending, but can be noted in rotation and lateral bending. It does not often appear, alone, as a symptom, but is a more or less constant finding in conjunction with others. On the other hand, according to Downes (9), the perception of this finding may not be noted until physical examination is done. For a thorough examination the patient should be stripped, and the procedure aimed at the discovery of this important finding. Because of the normally small amount of movement and synovial membrane between

individual vertebrae, the loss of normal movement and pain on passive motion is more obscure than in other, more freely movable joints affected by tuberculosis. In the cervical spine, muscular rigidity should be made apparent through all movements except perhaps rotation. In the thoracic, or dorsal, it is seen best on rotation and lateral bending, and in the lumbar it is best demonstrated on dorsal extension, as by laying the patient upon his face and hyperextending the spine; it should also be made apparent by his stooping, with the knees held straight, by bending the whole trunk laterally in both directions, and in rotatory motion, by holding the pelvis still and having the patient twist to look behind him over both shoulders. Psoas spasm is demonstrated by flexion of the thigh, but when not so perceptible, may be demonstrated by limitation in ability to hyperextend the thigh, or even with having assistance in this movement. Bending the spine is painful (26), or even impossible, and in getting up from lying position, the patient supports the weight of the trunk on the knees, with the hands and arms, and in sitting he will use the arms to support himself and so take the weight of the head and shoulders off the affected areas in the back. In this muscular rigidity, also, we see the attempt on the part of the patient to keep the diseased and inflamed

areas quiet, as motion causes pain.

Spinal weakness--this finding can usually be perceived along with the tests for muscle spasm or rigidity, and a good many of the signs previously mentioned in connection with the latter, will at the same time demonstrate this weakness. Examples of these are to be found in: the support of the trunk by hands and arms when in the sitting position, lifting the weight by knees and hands when arising from the supine or prone position, holding the chin in the hands, and so on.

Deformity (kyphosis). This is of course a late sign and it is desirable that it not be necessary for a positive diagnosis of the disease. The mechanism of the two types, the backward curvature, and the backward angle or gibbosity, has been, I think, satisfactorily explained in this paper, in the section upon pathology and morbid anatomy. Never, or rarely does a knuckle appear with disease of the cervical region, but often the distinct shortening of the neck is apparent (26). In the dorsal region, the backward curvature or knuckle most frequently occurs, and is apt to be very marked, due to the anatomical set up, and the pathology. In the lumbar region, knuckling may occur, but rarely is it so extensive, or marked, as it is in the dorsal region. The lumbar spine may shorten in the same way as



the cervical, giving the appearance of a very short trunk and long legs.

Abscess and Paralysis or paraplegia. Although these findings might be considered, by some, with the clinical features and symptoms, they are not really symptoms, but complications, and in this paper will be considered under that head. (33).

Herpes zoster. Although little was seen in my reading upon this as an early manifestation of tuberculosis of the spine, an article by Rosenthal (25) reported such a well defined case, and he states that "from a review of the literature, there seems to be a definite association between herpes zoster and tuberculosis, proved clinically and pathologically." It is probably the result of implication of the posterior root ganglia in the inflammatory processes secondary to the original tuberculous focus, since the particular case he cites showed 16 months after first observation of the zoster, in which the carious vertebrae corresponded to the same spinal segments involved in the zoster. It seems that, although recent dermatological and orthopaedic literature does not refer to it, that it is a point of some significance.

## DIAGNOSIS

As may have been seen from the foregoing the diagnosis of Pott's disease, at an early enough stage, is not always an easy thing. Earlier diagnosis than is at present common, is to be striven for, according to most authors. Hibbs and Risser say (19), "the diagnosis of tuberculosis of the spine should be possible very early by x-ray and physical examination. The hope of improving the results in the future depends upon the education of the medical profession in the methods of early diagnosis and upon their urging immediate attention." Capener (6) says, "The classical picture of a patient with a kyphos, muscle spasm, limitation of movement in all directions, associated with a history of backache worse at night, chronic cough, loss of appetite, wasting and perhaps the presence of a psoas abscess or paralysis, is terribly easy to diagnose; it is terrible as indicating a late stage of the disease. The diagnosis of Pott's disease must be made, if possible, before destruction of bone has occurred, and before the formation of abscesses. Spinal tuberculosis demands great care in its early diagnosis, in the discovery of the primary focus and in its observation for development of associated tuberculous lesions."

History. The need for a very careful history is quite apparent, and has already been said, is in some cases very difficult to obtain. In the case of young children this lack of observation might, infrequently, be attributed to a discounting, on the part of the parents, of the importance of complaints the child has made, but is probably more often the result of the insidiousness and obscurity of the onset, and the necessity of some dramatic sign to call attention to the disorder. Vickers (33) says "The majority of patients are brought to the doctor on account of a 'lump in the spine' which the mother noticed only that day, the other symptoms having been absent or considered of only slight importance." Another bearing this procedure has is upon the determination of other tuberculous lesions, and thus the location of the primary one. Concomitant tuberculous lesions were found in 53% of a series studied by Döub and Badgley (8).

Physical Examination. The importance of a thorough and complete physical examination, with particular reference to the spine, has already been stressed, (see under clinical features and symptoms), and does not need further discussion here. It is of importance also, in the discovery of other tuberculous lesions. The physical examination and the history, which go to make up

the clinical picture, are of primary importance in making a diagnosis of Pott's disease. That is, it may antedate the skiagram findings, so the latter, as well as other laboratory findings, are to be taken as confirmatory findings, and in case they do not uphold the clinical picture, the latter is still the diagnosis. (9)

"Often there is kyphosis, cold abscess, or even paraplegia to help with a diagnosis - but even the kyphosis, alone, is not pathognomonic." (9)

X-ray. The importance of the x-ray in the diagnosis of Pott's disease is not to be slighted, although, as was just said, it cannot always be considered as an absolutely irrefutable sign. Both anteroposterior and lateral views should be taken - "the well-known liability of the dorsolumbar junction to both trauma and tuberculosis should emphasize the need for careful lateral studies, by x-ray, in this region." (6)

It is important that (8) "the roentgenologist know the pathological findings in tuberculosis of the spine and must be able to correlate these with the corresponding roentgen signs."

Roentgenologically, three types of lesions can be distinguished - the central type, the intervertebral articular type, and the anterior type (8). The central type causes collapse of the body of the vertebra in most

cases, while in the intervertebral articular type, the body form is preserved until late in the disease. "The narrowing of the disk is the earliest and most constant sign in tuberculosis of the spine.(8)"

"In the ~~intervertebral~~ articular type (7) the early diagnosis is often difficult because of the lack of deformity, and roentgen examination here is probably the chief form of early diagnosis. The early roentgen signs are narrowing of the intervertebral disks with erosion of the articular surfaces, but with preservation of the body form."

Blood Picture. The blood picture in Pott's disease is not the picture of an acute infection. There is a low total white count with a relatively low polymorphonuclear count. The blood picture, like any other single finding, is by no means pathognomonic, but can be used only as confirmatory evidence. (36)

Tuberculin Tests. As in other tuberculous conditions, a positive tuberculin test is of no especial value, (36), but repeatedly negative results of these tests, Von Pirquet or Mantoux, are of definite diagnostic value in ruling out tuberculosis. A slightly different opinion from that of Yount, just given, is that held by Downes (9) who says that a positive test is of value in children; the younger the patient, the

greater the value of a positive test. This stipulation, we see, is because of the probability of a positive skin reaction, in adults, even young adults, resulting from healed tubercles of no significance, and which are so very often seen.

Yount (36) is not so hopeful of an early diagnosis when he says "On account of the insidious progress of bone destruction, the lapse of time alone is necessary to establish a positive diagnosis."

Differential Diagnosis. Perhaps the most comprehensive, though concise, differential diagnosis is that given by Downes (9) who says: "The list of conditions in which a wrong diagnosis can be made is long, but in only a few of this number is it very common. A list of the most common follows.

1. Local injury - the resultant stiffness and tenderness persisting is perhaps the most common. Continued observation with heat and x-ray generally shows the condition to be transient. This problem is increased by an element of hysteria.
2. Unusual prominence of the spinous processes of the cervicothoracic boundary. The diagnosis should be made by the means of x-ray.
- 3.. Osteoarthritis, in adults - the distribution is usually far more extensive than that of tuberculosis. X-ray

reveals characteristic changes. In children it is accompanied by other characteristic symptoms.

4. Scoliosis. This is a problem especially when it is associated with congenital deformity of the vertebrae. Though it is not characteristic of tuberculosis, some degree of lateral deformity may occur. Careful examination of the spinal movements, and x-ray should clarify the diagnosis.

5. Chronic abdominal pain is to be differentiated from tuberculosis by the x-ray, spinal movements, etc.

6. Tuberculosis of the hip joint - gives a psoas spasm as in Pott's disease and abscess, but all other movements of the thigh are diminished as well, which is not the case in Pott's.

7. Kummel's disease - here the differentiation is difficult, especially if kyphosis is present. In Kummel's the symptoms follow a latent period after injury (as compression fractures). The vertebrae are wedge-shaped, but here the intervertebral disks are intact.

8. Calve's disease - (osteochondritis of the vertebrae) occurs in children usually younger than the range of Pott's disease.

9. Scheuermann's disease - (vertebral epiphysitis) does not occur until puberty. Satisfactory skiagram is necessary, and will show, in Scheuermann's, a blurring of the epiphyseal plate and intervertebral disks. The

vertebrae are not wedge-shaped.

10. Acute osteomyelitis is rare in the spine, the symptoms are of course very acute, and very severe.

11. Typhoid and gonorrhoeal spine. Here the history should differentiate. X-ray can be used if necessary.

12. Syphilis. Here the x-ray will show more new bone production than in Pott's disease. The results of anti-luetic treatment will further assist, as will the Wassermann reactions. A tuberculous spine may, however, occur in a luetic individual, and vice versa.

13. Malignancy. This is usually secondary in the spine. The history is usually suspicious, and x-ray is of value.

14. Hydatid disease. X-ray differentiated this from Pott's disease very readily, particularly so in children.

Of the above list of conditions to be differentiated from spinal tuberculosis, the last five mentioned are of only rare occurrence, and not the common problems that are represented by those others.



## TREATMENT

In regard to the treatment of Pott's disease, we have two rather distinct schools of thought; (a) the conservative, advancing the principles of splinting and fixation of the spinal column, and thus assisting Nature's processes of repair; and (b) the operative fixation of the spinal column, augmented by splinting, or at least immobilization. As might be expected in such a case, there are given, by different authors, and depending on the degree of their particular enthusiasm for their choice, a variety of indications for one or another of the methods. I have tried, in this case, to pick my references in regard to the size of the series reported, and the length of time over which observations have been carried on. It is quite conceivable that here, as in any other field where thought is so divided, each of the two methods will have its very ardent supporters. Also there will be certain individuals who are not so strongly prejudiced, and who are able to see both the strong points and the weak, of each of the two methods.

In quotation of several of the authors I give: Ragolsky (22), in support of the conservative treatment says that true fusion of the vertebrae, "a process of healing whereby two or more vertebral bodies become molten rather

rather than the fusion of the spinous processes and laminae", cannot be obtained through operative fusion of the column, but only through natural processes furthered by conservative treatment. He quotes N. Allison's article in Surgery Gynecology and Obstetrics for July 1927, in which the author states that: "the greatest catastrophe of surgical tuberculosis is surgical interference, both in adults and in children".

On the other hand Vickers (33) states that "spinal fusion, by operative methods, should be attempted in all patients over twelve years of age."

We see, in these quotations, the wide diversity of opinion that is prevalent among those who are treating Pott's disease in this country and in others. It is necessary, then, to consider both methods from all angles possible.

#### Conservative Treatment

"The whole object of treatment is to protect the vertebral bodies from jar and superincumbent pressure until a cure is established. Therefore the superimposed weight must be removed from the part affected, and the spine so fixed as to secure rest and protection from motion to the vertebral bodies.

"With the normal tendency for the weight of the head, shoulders, and thorax to bend the spine forward and so compress the vertebral bodies and intervertebral

disks, no satisfactory and ambulatory treatment, at least in the acute and subacute cases, has been devised, which will secure a diminution in the activity of the disease, and a prevention of the increase in the kyphotic deformity." (26)

This description of the general conservative treatment, as outlined by Sever (26), is comprehensive and was used for this paper as the ground work, to be augmented by references to the works of other authors.

The principles of the treatment are stated by Vickers (33) as follows: (a) Elimination of superimposed weight, through bed rest and recumbency. (b) Immobilization of the diseased part of the spine, by suitable splinting. (c) Promotion of hyperextension, likewise by suitable splinting, and (d) Improvement of the patient's general condition, by good food, open air, heliotherapy etc. The last principle involves the general fundamentals, of course, of an individual with any tuberculous focus, and which hardly needs to be discussed in this paper. These principles of Vickers' then correspond rather closely with those given by Sever's account of the objects of the treatment.

Sever gives four methods by which to give treatment in recumbency, which is the only way in which we can prevent increase in extension of the disease, and,

likewise, give the patient comfort. (a) Bradford frame, used in dorsal and lumbar involvement. (b) Head fixation, for cervical involvement. (c) Plaster shell, used for the same purpose as the Bradford frame. (d) Plaster jacket, used during the subacute and ambulatory stages, and giving better fixation than can a steel brace.

The method of handling a patient with Pott's disease is very important; he should never sit up, lie on the side (which twists the spine), or bend forward. He may, however, lie on his face. The process of turning such patients in bed should be carefully watched; the arms are extended above the head or are held close to the sides, and the patient rolled in one piece, as one would a log. Later, when he has become ambulatory, the steel brace or jacket, or the head suspension and fixation, relieves the superincumbent weight upon the spine. The brace straightens the spine backward, by leverage at the point of the disease, and is not a means of direct support or relieving superincumbent weight. Lying flat on a hard surface relieves the spine of weight bearing; this is not so in the case of a soft mattress or a bed, and twisting or turning may injure the diseased vertebrae. Therefore the patient is recumbent and secured to the flat frame, or Bradford frame, arched

Whitman frame, or posterior plaster shell, molded to the back.

The Bradford frame is a flat, rectangular frame of gas pipe, the size of the pipe varying with the weight of the patient. It should be from four to six inches longer than the patient and its width should equal the width between the anterior superior spines, as if it is too wide it does not serve well for fixation. The covering is of stout canvas or duck, the length of the frame and wide enough to overlap at the sides and lace up taught behind, preventing wrinkling and sagging. Unless the patient is small enough to use diapers, the covering is in two parts, leaving a space four inches wide, for the buttocks and permitting the use of a bed pan, without displacing the spine or hips. Support can be given to the frame, in the case of tall heavy children, by a metal cross-piece at the level of the middle of the thighs. The covering should be kept clean with a smoothly folded, changeable sheet. In case there is a kyphos, it is raised by pads, at either side of the spine, of folded pillow cases or felt, hyperextending the spine and preventing bed-sores.. The patient is secured to the frame by two crossed webbing straps over the shoulders, under the arms, and buckled under the frame. A towel folded to a narrow width is passed under the frame and pinned around the hips, and another

around the knees in the same manner. When there is a psoas contraction, demanding that the legs be raised, pillows and folded sheets may be used, but a wooden inclined plane is better with a cord, pulley and weight, and adhesive plaster extension as in hip disease; the traction here is applied in the line of the flexion deformity.

Briefly, the care of the patient on the frame is as follows. Clothing consists of a gown, opening in the back, or for the outdoors, a jacket similarly cut, plus cap, mittens, and a blanket around the rest of the frame. Usually the patients can feed themselves, and can drink through a tube. A daily morning bath is given, with the patient recumbent, and in the evening an alcohol rub of powder, turning the patient on the frame as was described earlier - rolling him like a log.

Similar to the Bradford frame is the Whitman, or arched frame, differing only in that; it is slightly narrower ( the width equals the distance between the glenoid cavities or femoral arteries ), and that it is bent under the deformity so that the patient lies bent over a double inclined plane, with the head and feet low. Felt pads, sewed to the cover, protect the kyphos. A clean sheet is used for a cover. The frame is bent only slightly at first, and gradually raised each day

until sufficient. The bed should be opposite the point of deformity.

The plaster bed is a posterior shell with an anterior lid, made of ordinary five inch plaster bandages. The patient is placed face down, in a hammock, with the arms at right angles to the body, and dressed in a stockinet shirt from the top of the head to below the knees. The apex of the deformity, and an area around the buttocks are marked, to be cut out later. The head spine and legs are held in the same straight line, and the first bandage applied in continuous turns from the knees to the axillae. Half turns of bandage are then made, well out over each shoulder, and including each side of the head and neck. Successive half turns are then applied to the back and thighs to the midaxillary line on each side, and the last plaster makes continuous turns as did the first. The shell should not be over one half inch thick, and the neck, which is apt to be the weakest point, receives particular attention. Remove the shell by making a longitudinal cut on the ventral surface, and spreading the sides well apart. It is immediately trimmed, the opening for the bed pan cut, lined with felt, and covered with stockinet. The anterior shell is made in the same way but with the patient on his back. The plaster is carefully molded, especially about the chin, and between

the legs to insure an accurate fit. Strap on this anterior half before turning the child out of the posterior shell, as for nursing care, then turn him on his face, lying on this anterior shell, or lid.

Traction to the head is useful in cervical, high dorsal, and lumbar Pott's disease; (a) during paraplegia, (b) relieving referred neuralgic pains in cervical disease, and (d) in overcoming muscle spasm. It is applied by the use of a simple webbing strap and buckle, covered with soft flannelette, around the forehead and occiput; a strap, at right angles to the first, goes from above each ear to a spreader a little wider than the biparietal diameter. There is a cord from the center of the spreader, over a pulley at the head of the bed, four inches above the mattress, with a weight of three pounds or less for a child; counter pull is obtained by: (a) raising the head of the bed, or (b) downward pull from a waistband or adhesive plaster extension.

The Thomas collar is also widely employed in cervical cases, with excellent results. It is useless in cervicodorsal or high dorsal disease, unless used in conjunction with a brace or jacket. It is a collar of soft leather in a tubular form, and stuffed with sawdust; making a thick collar for the neck and fastening at the back with straps and buckles. Similar supports



which are very good are of celluloid or leather stiffened with celluloid, modelled upon a cast of the chin, occiput, shoulders, and neck. For true fixation they should extend as low as the xiphoid process.

The plaster jacket, as was stated, for the subacute and ambulatory stages, is applied either with the patient held in the erect position by head traction, or with the patient lying on the back or face, whichever posture gives the best bodily position, and leverage on the diseased area. An undershirt is put upon the patient, the bony prominences covered with thin felt, and the kyphos protected with felt which is split in the middle and passed on either side of the spinous processes. A pad of folded sheet wadding is placed, outside the shirt, over the abdomen, to be removed as soon as the plaster is dry. This prevents too great compression upon the abdomen. In older children, especially girls, the chest and breasts are similarly padded. The plaster is applied so the jacket fits snugly about all bony prominences, and holds the back in moderate hyperextension. The jacket is trimmed when dry to allow a comfortable sitting position, and under the arms if necessary, for if it is too high there, a "crutch paralysis" is apt to be the result.

The Calot jacket is a modification, incorporating support to the chin and occiput, and having a window

over the kyphos. It is useful where the disease is above the eighth dorsal vertebra. "We need support for the head in all cases where the upper six dorsal, or the cervical vertebrae are involved. The

The general considerations, in this conservative form of treatment, as given by Sever, were these.

The inefficiency of support is indicated by pain, weakness, loss of the use of the legs, and increased reflexes. Recumbency in a plaster shell is thus indicated. A child in a plaster jacket should be very carefully watched, and frequently inspected.

Take care that patients when first out of bed do not overdo and thus excessively tire themselves. Gradually they work into being ambulatory. At first they should always be down during the middle of the day.

Although the longer jackets can be worn without changing the better is the cicatrization in the spine, the object of treatment, they are liable to be broken, soiled, and even infested with vermin. For these reasons a careful watch should be kept, and jackets changed when necessary.

A jacket is usually good for from fifteen to sixteen months. The whole course of this conservative treatment may be from four to five years. Removable jackets and braces are more cleanly but less efficient, in that they require such constant adjustment and such great care and

attention on the part of those who help in putting them on. These braces should also be seen by the surgeon once a month for checking of any possible errors which might develop in the accuracy of the fit.

Rogolsky says about conservative treatment (22), "the ideal end result or cure in the treatment of spinal tuberculosis is reached when there is a definite bony fusion of the affected vertebral bodies. In order to attain this goal prolonged, uninterrupted recumbency is imperative".

N. Allison states that "the matter of resumption of function is decided by the roentgenologist. When the x-ray plate shows sufficient bloc about the diseased vertebrae, then it is decided that the patient may be up and about."

Glissan (14) gives as his choice of treatment, after operative fusion, "A series of well-fitted plaster jackets. It must be remembered that while the wearing of a jacket protects against angulation, it does not prevent the crushing effect of the suprajacent portion of the trunk upon the diseased vertebrae. For this reason a person wearing a jacket should spend as much of his time as possible upon his back." He also says that no jacket is efficient, during the active stages of the disease, unless it extends from the lowest possible

point about the pelvis, to the neck, terminating in a well fitting collar.

### Operative Treatment.

The operative treatment, performed through arthrodesing operations of the spine, has two main divisions. One technique was developed by F.H. Albee, and one by R.A. Hibbs; the operations bear the names of their respective originators. Steindler says (23) that "the operations upon the spine in Pott's disease are not operations for tuberculosis in the strictest sense of the word, they are operations to establish immobilization." And immobilization, as we know, is one of the fundamentals in the principles of treating Pott's disease.

Steindler says also, that in his indications for the operative treatment, there are certain disadvantages of the conservative.; its uncertainty, prolongation of the period of treatment, and the enforced recumbency, and in which the economic element must be considered.

Contraindications, as given by Steindler (23) include: (a) The general condition of the patient so precarious that he is not equal to the hazard of the anesthetic and operation. (b) Cases with sinuses within the operative field. (c) Cases with severe paralysis of long standing, and bed sores. (d) Children under three or four years of age. (e) Occasionally, in adults, the

presence of extreme deformity or of multiple lesions of the spine, unless they are in close contact with one another.

Albee (3) differs, as to the contraindications, from Steindler. (a) He says that paraplegia does not contraindicate operation, nor does the presence of a psoas abscess. (b) As to the general condition of the patient, his only contraindication is hyperpyrexia due to secondary infections with pyogenic organisms. (c) With regard to the patient's age, Albee says "take advantage of the speed and safety afforded by operation in aiding toward ankylosis". He may, in some cases, use the conservative treatment later, just as though the operation had not been done. (d) With regard to the multiple tuberculous foci, this author records very favorable results from operation done in the face this condition. Albee reported, in this particular series, two hundred eighty five cases, in which 96% were observed for periods greater than one year, 63% from one to five years, and 31% from five to as much as nineteen years. In making comment he remarks upon the extreme variance in virulence and response to treatment, among cases of Pott's disease, and the difficulty in foretelling the nature of this response, whether conservative methods will or will not be effective. "Since one cannot fore-

tell, there is only one attitude to adopt toward a given case, and that is to consider that it may be unfavorable and to operate in every case. To be sure, a certain number of cases respond to any treatment; it is this small percentage which has encouraged some surgeons to use conservative methods and to prolong them, even in the face of clear evidence that the case demands radical treatment."

Albee Technique. (3) In acute cases prepare the patient with a marked kyphosis for the operation, by recumbency on a Bradford frame for a time, to at least partially correct the deformity. There are two different techniques used by Albee, with the exposure and preparation of the spinal gutter the same in both. "The spinous processes of the affected vertebrae, and of two above and two below in the dorsal region (only one above and one below in the lumbar), are split, in situ, in halves longitudinally, almost down to the neural arches ". A special broad thin osteotome is used here because a saw is too difficult to guide. Fracture only one side of each pair of the spinous process halves, or else continuity of the blood supply through the graft into the vertebral body is interfered with, immobilization of that vertebra, immediately, is not effected, and there is the risk that because of low osteogenic

power, reunion of the spine may not occur and thus the vascular and mechanical support is lost. The gutter for the graft then is bounded by a row of fractured half spines on one side and unfractured on the other.

The first technique now consists of a single graft from the tibia, long enough to cover the entire length of the gutter, including that in the intact vertebrae. The diameter of the graft should be one fifth that of the tibia.

This single graft is shaped only a little by cutting the upper and lower portions at an angle to the axis of the midportion, which crosses the crest and gives a graft with some curve; but the tibia is not wide enough to give a single graft suitable for more than a moderate kyphosis. If undertaken early enough the deformity should not be too great for the single graft.

The graft is flexible since it is cut first with a twin saw, about one half inch apart, then intermediate cuts, not quite so long as the first two are made with a single saw. This leaves a bridge of uninterrupted bone at either end, and after the transverse cuts are made the graft is lifted out in one piece, extending into the marrow of the tibia. The graft is then bent into the gutter and held with interrupted sutures of kangaroo tendon as the molding progresses, the first

point of attachment being with one end of the graft in the more unfavorable end of the gutter, where it has been fastened with kangaroo tendon passing through the split supraspinous ligament; it should be as closely approximated as possible to the two halves of the spinous process, which has been stripped of the periosteum to receive it. The extreme end of the graft is held with a transverse locking graft of bone, as was the first, and which prevents the end of the graft from springing out of the gutter posteriorly. This cross graft is suitable in the second technique, as well as in this one, being a type of anchorage which is more secure as convalescence progresses, for the cross graft, of autogenous origin, unites with the spinous processes and the main graft.

The second technique, or "bundle of reeds" graft is used where the kyphosis is too extensive for the tibia to supply a long enough graft. The intermediate cuts in the graft are carried its full length, making separate strips. This "bundle of reeds" is then placed in the gutter and fixed at its midpoint with kangaroo tendon; the individual grafts are then telescoped out to cover the entire graft bed. Even in adults, if accurately cut, these strips bend readily without breaking. Since practically the whole length of the tibia



is available as a source of bone graft, this method is resorted to only in extreme cases.

The postoperative treatment used by Albee is: (a) Children under ten - recumbency for a minimum of five to six weeks, according to the progress, and then a Taylor's brace for from five to six months, as indicated. (b) In adults - first use a strong straight or shaped graft, then recumbency on a fracture mattress for from six to eight weeks; throughout the whole course, maintain a regime suitable in every particular to a tuberculous patient.

Common errors in technique, as Albee gives them, are: (a) The graft is applied to the wrong vertebrae, being too high or too low. (b) The graft is not long enough to include the requisite number of healthy vertebrae. (c) The graft is not strong enough to resist fracture and supply immobilization.

He gives, as the result of the study of this series: Excellent results in 90% of the cases. In eight percent, the results were "fair", that is, they experienced moderate pain at times, or were unable to do more than light work, or to exercise without restriction. This was not the case in those reported as "excellent". Seventeen cases out of this series died, three of them during convalescence.

Hibbs' Technique. The technique devised by Hibbs is somewhat different from that of Albee, in that it is an osteoplastic operation, by which the intervertebral articulations are obliterated, and bone bridges produced, forming in the end a solid fusion between the neural arches and spinous processes of the adjacent vertebrae. Secondary operations will show solidity and firmness of these bridges which eventually form a solid plate on the posterior aspect of the spinal column, if the operation is done correctly; the spinous processes, laminae and articularia are all fused into a solid plate of bone.

The technique starts with an incision through the skin and subcutaneous tissue from above downward, exposing the tips of the spinous processes that are to be fused. (28) The periosteum over the tips of these processes is first split longitudinally and stripped to each side with a periosteal elevator or forceps. Thus is located the plane in which the stripping is to proceed. The entire dissection of the posterior aspect of the spinal column must be carried out subperiosteally. Further split the periosteum and interspinous ligaments, and push them forward from each spinous process. Gauze packs prevent bleeding. From one vertebra to the next, always strictly in the subperiosteal plane, carry on the dissection, gradually laying bare the spinous processes, the posterior surfaces

surfaces of the laminae, and finally the transverse processes. Painstaking procedure in this dissection, keeping to the subperiosteal plane, is absolutely essential. Remove the ligamentum subflavum from the margins of the laminae and articulations of the lateral processes. Eventually, the operator has before him, the periosteum laid back, as an uninterrupted sheath, and the whole posterior aspect of the spinal column bare. Bleeding is thus better controlled, and a dry field is essential.

The intervertebral articulations are now destroyed, and good exposure here is important, by curetting out the entire cartilage covering, of one vertebra after another. Now the bony bridges are to be made; from the neural arches raise, with a suitable gouge, small bone flaps, adherent at their bases, in number two from each lamina; one flap is turned upward and one downward, to make contact with adjacent laminae, making a double contact between them. Next the spinous processes are broken down with a specially constructed bone forceps, each process being ripped halfway through at its base and broken down, so that its tip comes in contact with the bare bone of the vertebra below. The spinous process of the last vertebra below is turned up to make contact with the one above. With this the plastic work is ended and the entire periosteal sheath is again brought together in the mid-

line, and sutured with interrupted cat gut sutures. The subcutaneous structures and the skin are closed above it.

It is especially important in this operation to work in a dry field, and with as little injury to the muscles as possible, so that careful hemostasis is possible. This can be accomplished only by progressing carefully in the proper plane, normally beneath the periosteum. The careful dissection occupies the largest part of the operation, and is by far the most difficult.

The after treatment used by this author is the bivalved plaster bed or shell, which has already been described. It is prepared a few days before the operation, the patient using it from the time of preparation on, and immediately upon the conclusion of the operation, he is replaced in it. Absolute recumbency follows the operation for a period of eight weeks, then he is allowed up, in a body cast. After six months he may walk freely, and is supplied with a back brace giving full freedom of locomotion. The brace should be worn for a period of not less than one, and preferably two years, when he should be ready for freedom from any apparatus.

Steindler says (28) about the arthrodesing operations in general, "Both methods occupy considerable time if carefully performed, There is some surgical risk then, probably greater in the Hibbs operation since it is

the most difficult to perform. The patient's condition must be good before the operation and carefully supervised during and after it; we must be in constant readiness to combat shock. Asaline infusion during, or immediately after the operation is good. Both methods are surgically and mechanically correct, producing extreme solid union when properly performed. In placing the inlay it is important that the cancellous bone of the graft and the spinous processes are apposed, and that the periosteum is to the outside. In case of fracture grafts can throw out their own callus; absorption can take place, however, followed by pseudarthrosis, in either process. This is due not only to excessive motion, but also to strain, which favors absorption, and which is too subtle to be controlled by external fixation. In either method there is tension strain upon the graft, and attempt at forward motion of the bodies. In the Hibbs method this strain is less because the fusion is nearer the center of motion; The mechanical conditions then might be called better in the Hibbs operation.

"The advantages of operative treatment are not in a direct curative effect, but in the effect on the course of the disease, making it move more freely of complications."

"In 80% of all cases (Steindler's series) ankylosis or fusion was found to be complete. With improvement of technique this percentage should definitely increase; therefor the primary object of the operation, namely, the internal fixation, is definitely and satisfactorily obtained. There is considerable shortening of the time of immobilization, as well as a probable favorable influence on the course of the disease; indirectly there is favorable influence in the prevention of complications. The late mortality, as established to date, is still lower than the average late mortality in Pott's disease in all ages, and under all conditions, when treated by conservative methods." (28)

Gratz (15) has given a slight modification of the Albee technique, which he used in an extreme case, with a kyphosis of forty five degrees, a psoas abscess which had discharged for six months, and involvement of the sixth to twelfth dorsal vertebrae. Four grafts were cut from the tibia, sufficiently thin to permit adjustment to the marked kyphosis. They were placed at right angles to the direction of the split spinous processes, with the periosteal and medullary sides being alternated, and were firmly fastened with kangaroo tendon. The trapezius muscles were lapped over one another to prevent the tendency toward the straining of the grafts;

the grafts were also placed one beneath the other, from above downward, thus giving the maximum thickness over the point of greatest kyphosis, and securing a leverage action tending to give firm immobilization of the diseased area. The author recorded very satisfactory results and calls this the "mutiflex graft technique".

## COMPLICATIONS AND THEIR TREATMENT

The complications of Pott's disease which are most frequently seen and most serious, and therefore the most important, are: (a) Gibbus, or hump. (b) Cold abscess. (c) Paralysis or paraplegia. Although in most cases the treatment of these things is embodied in the general treatment of Pott's disease, whatever the method used, a brief summarization here will not be amiss.

Gibbus, or hump. "This complication, if recent, may be corrected. If it is old, and characterized by bony or firm fibrous fixation, forcible reduction of the deformity is dangerous, and should not be attempted." (5) When there is a recent angular deformity, an accurately applied Calot jacket is often of benefit. This jacket has been described earlier in this paper, as well as its disadvantages, which must be carefully watched. The pads over the hump are renewed every three or four weeks, and this treatment maintained as long as is necessary. (5) The arched, or Whitman frame, in the treatment of Pott's disease, beneficial in restricting kyphosis and partially, at least, reducing it.

Abscess. This is by far the most serious complication of Pott's disease (35). A limited collection of pus is present at some time during the course of the



disease in nearly all cases, as will be confirmed by x-ray findings, but unless it reaches a size to make it appear as a tumor mass, to observation or palpation, its presence is often not known. The fluid in these abscesses is usually sterile, and before establishing connection with the outside, secondary infection is rare. If the abscess appears early and grows rapidly, it usually indicates a destructive, and rapidly advancing disease process; the slowly enlarging or quiescent abscess has little significance. These abscesses may remain fairly well localized, and eventually, if the disease process heals, become absorbed, but in most cases they grow and spread, and make their way, by extension down the spine or toward the body surface. Thus is a sinus formed, or even a fistulous tract when the body surface is reached.

The location in which these abscesses point is, of course, dependent upon their point of origination. When in the upper cervical region (5) they are most apt to point as a retropharyngeal abscess, on the posterior pharyngeal wall; in case that it ruptures here, suffocation is apt to be the result. In the lower cervical spine they may point in the posterior triangle of the neck, to the axilla, posterior mediastinum, or even extend behind the trachea and esophagus into the pleural cavity. If they originate in the thoracic region, the abscesses

usually burrow along the intercostal vessels, pointing under the skin in the region of the midaxillary line; less frequently they pass through the crura of the diaphragm into the psoas sheath and form psoas abscesses. Abscesses of the lumbar region may travel along the psoas sheath pointing in the inguinal region, or on the thigh, or, more directly, may go through the sheath of the quadratus lumborum forming a lumbar abscess between the twelfth rib and the crest of the ilium, in Petit's triangle; likewise the iliac, or even gluteal abscesses may be formed, and in a few cases, perineal location of the complication has been reported.

Careful fixation, by conservative treatment, or better still by operative means followed by conservative methods, is often sufficient as treatment, the abscess being absorbed as the healing process in the spinal column goes on. The question of opening them offers a point of controversy, as some fear the formation of a fistulous tract very difficult, or impossible, to heal. If these abscesses are opened, they should be tightly sealed up, immediately after drainage. In case of secondary or mixed infection, free drainage, sterilization, and incision of the infested sinuses, or open treatment with actinotherapy is resorted to (5). If the abscesses are very large, they may be opened, and iodine, iodoform, or

Calot's fluid may be injected. (33)

Paralysis, or Pott's paraplegia. This is caused by the tuberculous process breaking through the posterior ligament, entering the epidural space, and pushing upon the cord, giving paresis of the parts below the lesion (35). Usually the caliber of the spinal canal is not lessened although the weight and forward inclination of the spine forces the soft tissues back against the cord, producing the pressure. Rarely, a fragment of necrotic bone may <sup>cause</sup> cause the pressure. Paralysis is more often associated with moderate kyphosis than with extreme deformity. It is most frequently in lesions above the eighth dorsal vertebra, the upper and middle dorsal regions showing the greatest occurrence, as is the case of the abscesses. Usually the paralysis is a late symptom, appearing after the deformity, but occasionally even after the apparent cure. Early symptoms are usually weakness, awkwardness and a stumbling gait. The reflexes are exaggerated. Usually the degree of paralysis is the same on both sides. A peculiar spastic rigidity appears on moving the patient or stimulating the reflexes. Persistent contractions indicate, usually, permanent damage to the cord. Sensation is usually not affected. Usually the control of the bladder is lost, although in occasional cases it may be retained; the control of the sphincter ani is not affected.

The extent of the paralysis, of course, depends upon the situation of the disease, and the location of the pressure upon the cord.

Treatment of this paralysis is included in that of the tuberculosis proper, but in case of its appearance even greater care is necessary to assure spinal fixation. Manipulation or massage of the legs, since it stimulates the reflexes, is contraindicated. Laminectomy was at one time used but is now in disfavor, since the direct death rate is large, and recovery, although it may be slow, is usually the rule without operation. The first indication of improvement is lessening of the muscular spasm, followed by progressive recovery; at this time, massage is beneficial, rather than detrimental. (35)

Local paralysis may result from the involvement of the nerve roots near their exit from the spine. Actual compression is not usual since the nerves are embedded in fat and occupy only about a third of the space of the foramina. It may occur independently of cord involvement, and the symptoms are those of a neuritis of the affected nerves. (35).

## PROGNOSIS

"The prognosis of Pott's disease is usually good except when there is pressure on the cord, septic sinuses, bed sores, cystitis, or extensive tuberculous disease in other organs". Perforation of the dura by an abscess is followed by a rapidly fatal meningitis. With disease of the atlas and axis, sudden death may result from compression of the cord. (5)

Sever (27) says: "abscesses increasing in size represent increasing vertebral destruction, the shadow, on x-ray examination, representing bone detritus, plus local inflammatory reaction."

The above author further states that "calcification in an abscess generally is a sign of the quiescence of the disease and probably of healing. A decrease in the size, or early absorption of an abscess is likewise a favorable sign."

The roentgenogram is of great value, we find, in making our prognosis in a case of Pott's disease, but we must remember that a study of a single picture, while of interest from a diagnostic standpoint, is of much less value than a series of plates on the same patient, from the prognostic standpoint, for thus can be kept a constant check on the progressive favorableness or unfav-

orableness, of the changes in the spine thus exhibited.

Ghormley and Bradley (11) make the following comments with regard to prognosis. "(a) That calcification in a lesion does not necessarily mean satisfactory healing." Here they refer to the diseased area proper, not the complicating abscesses referred to by Sever who is quoted just above. "(b) The clearing or reestablishment of bony detail is a much better indication of healing. (c) Bony fusion or bony block is a favorable sign, (d) Decrease in the size of an abscess is a favorable sign, while increase is a decidedly unfavorable one. Here they further confirm Sever's statement in this regard. (e) Paravertebral abscesses accompanying dorsal Pott's disease are dangerous in that they cause a wider destruction than the original lesion. A mechanical pulsating force must play a part in their production."

Briefly, in the above, we have the main modern ideas as to the prognosis in Pott's disease. Of course further considerations are to be made, as the general condition of a tuberculous patient, and the prognosis of the disease in general, the favorableness or otherwise of the environment, and other generalities which hardly need be discussed here.

## SUMMARY

1. The knowledge of Pott's disease is not new to medical science, as it derived this name from an accurate description of some of its manifestations, written by Sir Percival Pott, of London, in 1779. Consideration of it antedates this, however, as is seen from writings of as far back as the time of Galen and Hippocrates, where they refer to such a condition.

2. The pathology is a chronic destructive osteitis, in which the bodies of the vertebrae, or the weight supporting portion of the spinal column, are attacked, after having been robbed in some manner or another, of at least part of the powers of resistance to such attack. The process leads to the formation of a knuckle, or kyphosis on the spine, at the site of the disease, through the collapse of these vertebral bodies in their anterior portions. The direct exciting cause is the tubercle bacillus, transmitted by the blood stream, from an original or primary focus somewhere else in the body.

3. The clinical features and symptoms form a very characteristic picture in the later stages, but are apt to be much more obscure in the early stages, and in very young children; since the history is apt to be vague, great care should be taken in obtaining an accurate one.

5. The diagnosis is not made, in a great many cases, as early as is desirable, due to the vague symptoms as stated, and the difficulty in obtaining an accurate history. X-ray plays a rather important part in the diagnosis of the condition, while other laboratory methods are not so significant in their results. The difficulty in diagnosis is responsible for a great deal of delay in instituting the proper treatment.

6. There are two schools of thought in regard to the treatment. (a) That which advocated only conservative methods for the production of fixation and immobilization (the primary goals in both methods), and permitting a natural bony or fibrous fusion of the diseased vertebrae. (b) That which advocates the use of arthrodesing operations on the spine, augmented by the conservative methods used as postoperative treatment. It is maintained that immobilization, and subsequent ankylosis of the diseased spine is thus brought about more quickly and more efficiently.

7. The complications that are common are few in number - mainly: (a) gibbus, or deformity; (b) abscess formation; and (c) paresis or paraplegia. The treatment for all of these is embodied in the treatment of the primary disease, the aforementioned principles of fixation, carefully done, and immobilization.



8, The prognosis is, speaking generally, good.

It is the presence of such things as pressure upon the spinal cord, with injury to that structure, septic sinuses, bed sores, cystitis, or extensive tuberculous lesions in other parts of the body, that causes the outlook to become less encouraging.

YORKLAND BIBLIOGRAPHY

notational error" . . . . 1931A (1)

- (1) Albee, F.H. "Transplantation of a portion of the tibia into the spine for Pott's disease". J.A.M.A. Aug. 1911
- (2) Albee, F.H. "Bone transplantation as treatment in Pott's disease". Post. Grad. N.Y. 27: 990 1912
- (3) Albee, F.H. "Bone graft operation. Twenty years experience". J.A.M.A. 94: 1467-1471 May 10, 1930
- (4) Albee, F.H. "Anatomicophysiological considerations in the treatment of Pott's disease". Am. J. Surg. 21: 204-209 Aug. 1933.
- (5) Babcock, W.W. "Textbook of Surgery". pp769-773 W.B. Saunders Co. 1929.
- (6) Capener, N. "Diagnosis of tuberculosis of the spine". J. Mich. M. Soc. 30: 431-434 June 1931.
- (7) Doub, H.P. and Badgley, C.E. "Tuberculosis of Intervertebral articulations". Am. Jour. Roentgenol. 27: 299-307 March. 1931.
- (8) Doub, H.P. and Badgley, C.E. "Roentgen signs of tuberculosis of the vertebral bodies". Am. Jour. Roentgenol. 27: 827-834 June 1932.
- (9) Downes, R.M. "Tuberculosis of the spine". M.J. Australia 1: 120-121 Jan. 24, 1931.
- (10) Freund, E. "Question of spinal fusion in spondylitis in childhood". J. Bone and Joint Surg. 15: 752-761, July 1933.
- (11) Ghormley, R.K. and Bradle, J.D. "Prognostic signs in x-rays of tuberculous spines in children". J. Bone and Joint Surg. 10: 796-804 Oct. 1928.
- (12) Ghormley, R.K. "Abscess of Pott's disease". Am. J. Roentgenol. 22: 509-516 Dec. 1929.

- (13) Girdlestone, G.R. "Operative treatment of Pott's paraplegia". Brit. J. Surg. 19: 121-141 July '31
- (14) Glissan, D.J. "Early symptoms and treatment of tuberculous disease of the spine".  
M.J. Australia 2: 253-254 Aug. 22. 1930
- (15) Gratz, C.M. "Pott's disease treated by multiflex graft technique". Am. J. Surg. 8: 618-620  
March 1930.
- (16) Henderson, M.S. "Operative fusion of the spine".  
Proc. Staff Meet Mayo Clinic 3: 194 June 27 '28.
- (17) Henry, M.O. "Tuberculosis of the fifth lumbar vertebra with spina bifida occulta; spinal fusion and cure". J. Bone and Joint Surg. 14: 690-692 July 1932.
- (18) Hibbs, R.A. "Treatment of vertebral tuberculosis by fusion operations". J.A.M.A. 71: 1372 1918
- (19) Hibbs, R.A. and Risser, J.C. "Treatment of vertebral tuberculosis by the spine fusion operation"  
J. Bone and Joint Surg. 10: 805-815 Oct. 1928.
- (20) Irish, W.H. "Pott's disease" Am. J. Surg. 7: 711-713 Nov. 1929.
- (21) Jones and Lovett "Orthopedic Surgery"
- (22) Ragolsky, H. "Tuberculosis of the spine, with particular reference to fusion of the vertebral bodies". New England J. Med. 200: 608-612 Mar. 21, 1929.
- (23) Rich, E.A. "Paralysis of Pott's disease".  
J. Bone and Joint Surg. 12: 112-130 Jan. 1930
- (24) Rigler, L.H., Ude, W.H. and Hanson, M.B.  
"Paravertebral Abscess; early roentgen signs of tuberculous spondylitis".  
Radiology 15: 471-479 Oct. 1930
- (

- (25) Rosenthal, T. "Herpes zoster and tuberculosis".  
J.A.M.A. 99: 213-214 July 16, 1932
- (26) Sever, J.W. "Text book of Orthopedic Surgery."  
pp. 102-126 MacMillan Co. 1925
- (27) Sever, J.W. "Abscesses in tuberculosis of the spine".  
J.A.M.A. 92: 1822-1824 June 1, 1932.
- (28) Steindler, A. "Textbook of operative orthopedics."  
pp. 196-205 D. Appleton and Co. 1925
- (29) Steindler, A. "Secondary pathological changes and  
management." Colorado Med. 25: 260-263 Aug. 1928
- (30) Taylor, R. T. "Orthopedic Surgery for Students and  
General Practitioners" pp. 67-68.  
Williams and Wilkins 1907.
- (31) Thomas, G.J. and Kinsella, T.J. "Inflammatory Ob-  
struction of the ureter, caused by psoas abscess  
secondary to Pott's disease".  
Am. J. Surg. 13: 72-74 July 1931
- (32) Turner, W.G. "Diagnosis and treatment of Pott's  
disease." Proc. Internat. Assemb. Interstate  
Post Grad. M.A. North America 6: 248-252 1931
- (33) Vickers, W. "Tuberculosis disease of the spine".  
M.J. Australia 2: 251-252 Aug. 23, 1930
- (34) Warren, A.E. "Mastoidectomy Complicating Cervical  
Pott's disease". Laryngoscope 41: 551-553  
August, 1931.
- (35) Whitman, Royal "A treatise on Orthopedics Surgery."  
pp. 18-111 and 236-240 Lea and Febiger 1919.
- (36) Yount, C.C. "Tuberculosis of the spine".  
Pennsylvania M.J. 33: 335 Sept. 1930.