TB – pre Columbian America.
HISTORY.

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Evidence for Tuberculosis i
Prehistoric Popula

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MENCING several thousand
before Christ and continuing to
time of European contact, the
istory of eastern North America
ays a series of cultural adapta-
In the earliest periods, hunting
gathering were the exclusive
omic pursuits; in the latest peri-
agriculture was the primary
uit. In a review of the paleo-
logic literature, Buikstra1 dem-
nated that cases of prehistoric
tal lesions, thought to be tuber-
s, were more frequently reported
the later agriculturally based
ps when compared with the
er hunting and gathering groups.
think that this association be-
n paleopathology and culture his-
is more than coincidental;
d, the paleopathologic and pa-
idemiologic record of eastern
h America closely mirrors hu-
culture history.

e report on skeletal lesions in six
prehistoric American Indians
ered from a burial mound at the
pin Farm near Cincinnati. The site, excavated by the Cincinnati Museum of Natural History, yielded the remains of approximately 290 persons who represented a sedentary village population supported by agriculture. A radioactive carbon date of 1275 AD (±150 years) places occupation of the village within the broad Fort Ancient tradition that occurred in the Central Ohio Valley from approximately 950 AD to 1750 AD.

Katzenberg,[2] who studied some of the skeletons, suggested the possibility of tuberculosis in three of the cases. It is our contention that these six cases collectively represent the strongest case yet for pre-Columbian tuberculosis in North America.

Report of Cases

CASE 1.—Remains of this individual suggest a woman between 20 and 25 years of age at the time of death. The lesion (Fig 1) involves the contiguous halves of L-2 and L-3. The vertebral bodies are eroded, and the intervening disk space is perforated. The lesion emerges posteriorly into the spinal canal. The remaining trabecular bone has become coarse and thickened. The level and locus of the lesion along with the lack of involvement in the neural arches are, at least, suggestive of tuberculosis. The posterior extension of the lesion, while not typical, does occur with tuberculosis.[3]

CASE 2.—Remains of this individual suggest a man probably older
years of age. This case is similar
The contiguous halves of L-3 and
2) are affected by an erosion in the
that emerges posteriorly; the cen
disk surfaces are again perforat
trabecular bone is even more e
and sclerotic than in case 1. A
level and locus of the lesion sugges
culosis.

CASE 3.—Remains of this individual
those of a man older than 35 years.
is collapse of the bodies of T-3 and T-4 (Fig
3), which has resulted in kyphosis and
slight scoliosis to the right; the spinal
canal has remained unobstructed. The
entire body of T-4 and the inferior half
T-3 are destroyed. The disk spaces be
T-4 and T-5 and between T-3 and
obliterated, while that between T-2 and
T-3 is preserved. There has been consider-
able fusion of the remnants of T-3 and T-4
to each other and to T-5.

In this case, the osseous reactions strongly suggest tuberculosis, although some other infectious process might be responsible. Reactive bone formation is prominent along the vertebral bodies and articular processes. In addition, there is marked osteophytic extension spreading inferiorly and superiorly on the left side. The end of a rib articulating with T-3 and T-4 is also involved in osteophytic growth.

CASE 4.—Remains are those of a woman approximately 16 to 18 years of age. The area of involvement extends from T-6 through L-3 (Fig 4). Massive destruction,

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collapse, and severe kyphoscoliosis are evident at T-8 to L-1. The bodies of T-6 and T-7 are eroded posteriorly. Only T6-7, T7-8, and L2-3 disk spaces remain. The collapsed bones also display extensive fusion of the bodies and articular processes; several drainage channels are also visible. A remnant of the right 11th rib is fused to T-11. The remaining vertebrae, L-4, L-5, and T-5 as well as some fragments of the cervical spine are free of lesions. Both the level and degree of destruction and collapse are strongly suggestive of tuberculosis.

CASE 5.—Remains are those of a woman between 16 and 18 years of age. The bodies of C-4 through T-2 show destruction and collapse (Fig 5); C-2, C-3, and T-3, though involved in the fusion, have intact bodies. The collapsed vertebrae exhibit a double scoliosis oriented to the right from T-2 to about C-7 and then to the left to C-2. Kyphosis is severe; however, the spinal canal is unobstructed. All disk spaces from C-2 to T-2 are obliterated. There is massive fusion but with no osteophytic spurring. Posterior fusion of the articular and spinous processes is more marked on the left side than on the right. While a locus of tuberculosis in the cervical and upper thoracic spine is not common, it is not unknown. This case, with its destruction of the bodies, consequent collapse, and subsequent ankylosis, clearly resembles case 3 and particularly case 4.

CASE 6.—Remains suggest a woman. A lesion is centered in the remnants of the left acetabulum (Fig 6). Much of the cortical bone is destroyed. A drainage canal penetrates the upper lateral side of the acetabulum and emerges on the medial surface of the ilium (arrows). Only the shaft of the left femur remains. The proximal portion displays medial periosteal reaction that extends to the linea aspera; presumably, the missing metaphysial and articular portions were even more severely compromised. The right acetabulum and femur were unaffected. This unilateral lesion of the acetabulum and proximal femur is highly suggestive of tuberculosis.

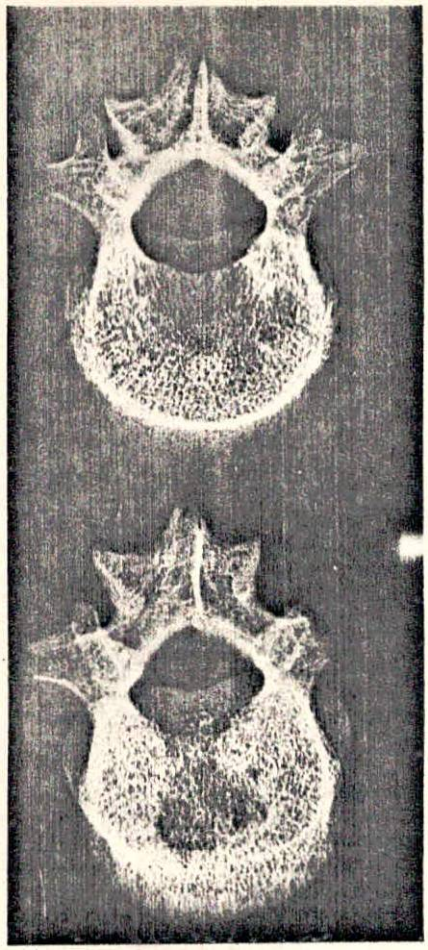


Fig 1.—Case 1. Superoinferior roentgenogram of L-2 (top) and L-3 (bottom).

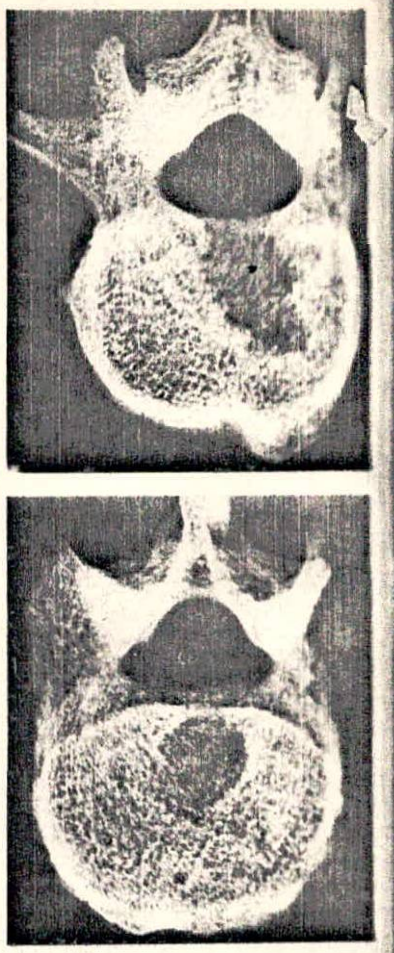


Fig 2.—Case 2. Superoinferior roentgenogram of L-3 (top) and L-4 (bottom).

Comment

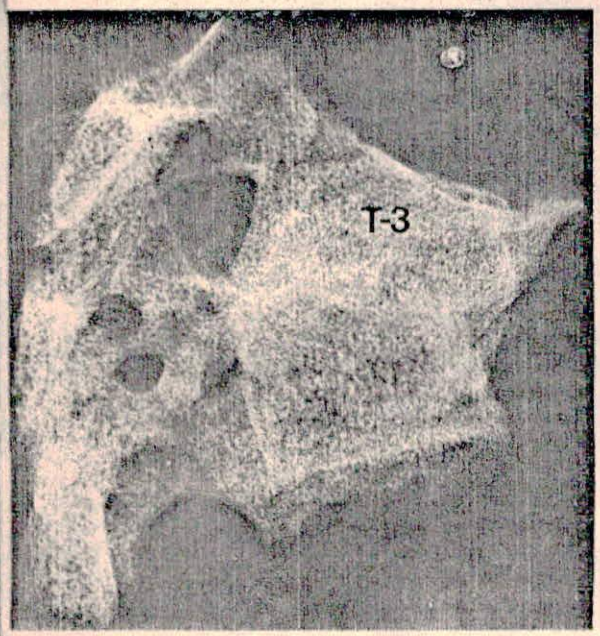
Despite the uncertainties in paleopathologic diagnosis, these six cases present strong testimony favoring the presence of tuberculosis in pre-Columbian North America. In a sedentary village population like Turpin, where tuberculosis is endemic, we would expect osseous lesions to occur preponderantly in the thoracolumbar vertebrae and less commonly in the cervical spine or hip. The pattern reported here is compatible with these expectations. Cases 1 through 5, moreover, follow the classic pattern of tuberculosis spondylitis; each individual suffered lytic destruction of either the center or the anterior portion of the vertebral bodies or both. In addition, the number of ankylosed vertebrae and the neural arch involvement are not inconsistent with this diagnosis.[3] In the healed stage, as few as two or as many as eight or more vertebral bodies may form one tuberculous block vertebra. Kyphosis is also not uncharacteristic.

We might anticipate that both subadults and adults would display such lesions. Unfortunately, subadults were underrepresented, accounting for only 42 of the 290 individuals we examined. Perhaps not coincidentally, no lesions resembling tuberculosis were recorded in this age group. However, three of the five individuals with spinal involvement were women approximately 20 years old or younger whose lesions suggested infection at a much younger age, followed by remission, healing, and ankylosis.

The severe vertebral destruction might also suggest bacterial or mycotic infection. Actinomycosis can probably be ruled out. The cervicofacial region is most commonly involved.[43] Actinomycosis rarely leads to collapse of vertebral bodies, fusion, or angulation of the spine.[44]

Spinal blastomycosis on the other hand, does show a predeliction for the thoracolumbar region[3] and is endemic in the Ohio River Valley. Furthermore, Buikstra[1] has suggested that exposure to a soil-borne fungus like *Blastomyces dermatitidis* probably increased with the adoption of agriculture by aboriginals. This would then conveniently explain the much higher incidence of vertebral lesions in later farming groups when compared with earlier hunters and gatherers.

We believe, however, that tuberculosis is a better explanation for the



1—Case 3. Lateral roentgenogram of T-3, T-4, and T-5.

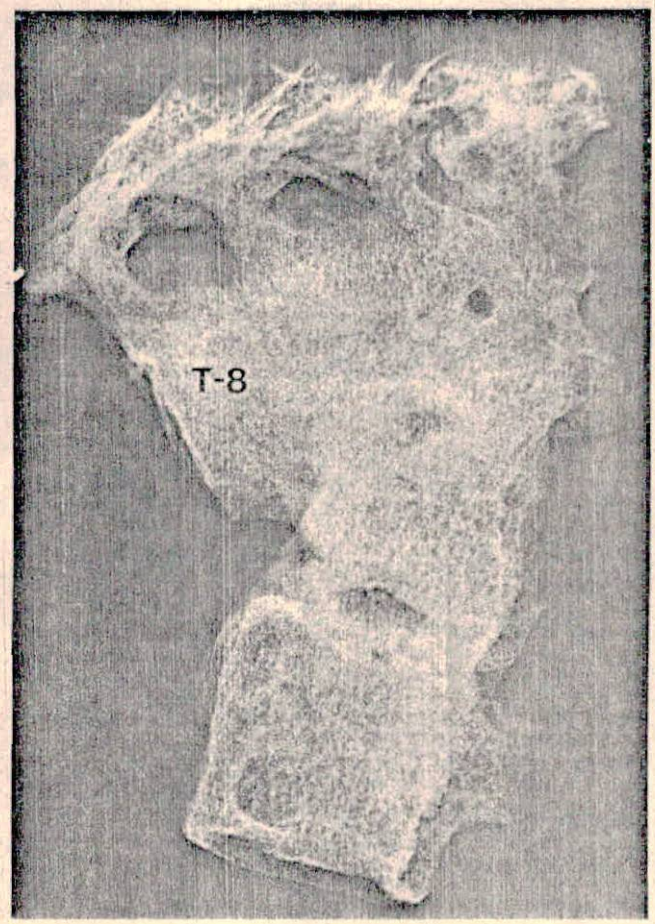
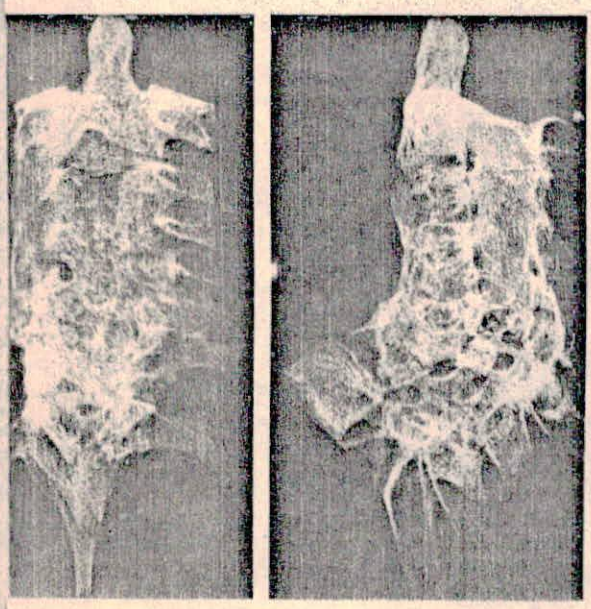


Fig 4.—Case 4. Lateral roentgenogram of T-8 through L-3.

Fig 6.—Case 6. Roentgenogram of remnants (arrows) of left acetabulum.

5—Case 5. Posteroanterior (left) and lateral roentgenogram of C-2 through T-3.



findings than blastomycosis. The ankylosis and extreme kyphosis of our cases are not typical of advanced stages of disseminated blastomycosis. Untreated blastomycosis rarely reaches a subclinical stage with spontaneous healing.[9,10] Blastomycosis, a rare disease, is not known to be transmitted from person to person[11]; rather, spores are first inhaled and only later spread through lymphatic and hematogenous dissemination. At the Turpin site, the similarity of the lesions and the number of individuals affected along with the apparent temporal and spatial proximity of the burials all suggest the presence of an endemic highly communicable pathogen.

Juvenile rheumatoid arthritis (Still's disease) is suggested by Katzenberg[2] as the diagnosis in case 5. It is typically a diffuse systemic disease with considerable peripheral joint involvement[12] and severe growth disturbance of the long bones.[13] Growth arrest lines are common.[14] The spine is most often fused at C2-3 and less often at C3-4 or lower.[13-16] Case 5 exhibits none of the classic characteristics of juvenile rheumatoid arthritis. Peripheral joints exhibited no arthritic pathology; long bones were free of growth arrest lines. Furthermore, the involvement of C-5 through T-3 is hardly characteristic of juvenile rheumatoid arthritis. We find more compelling support for tuberculosis, despite the cervical location.

Within the last 8,000 years, the virtual abandonment of hunting and gathering as a previously universal life-style had a profound global effect on prehistoric settlement patterns, social relations, technology, and diet. In eastern North America, for example, we can see important demographic changes as farming villages arose and increased in number and size.[17] Local population densities reached unprecedented levels; dependence on corn agriculture grew accordingly. The disease profiles of prehistoric populations changed commensurately. Indeed, tuberculosis-like lesions reported here and elsewhere and actually confirmed in a pre-Columbian Peruvian mummy[18] are largely confined to sedentary agriculturally based communities. On the other hand, earlier hunting groups were, no doubt, much less exposed to crowd infections like tuberculosis. As Dubos[19] emphasizes, most social and technological changes engender either immediate or delayed physiological disturbances and may act as direct or indirect causes of disease. This paleopathologic study, then, reaffirms this view and reminds us that sociocultural change is prominent in determining epidemiologic patterns.

Edward H. Miller, MD, and Michael Lapsansky, MD, of the University of Cincinnati College of Medicine, and Paul Jolly, MD, of the Hamilton County Coroner's Office, aided in the interpretation of the pathology studies. The skeletal material was made available by the Cincinnati Museum of Natural History. Margaret Wilson assisted in the preparation of the manuscript.

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New Appointments

Harold G. Jacobson, MD, new editor for the TOPICS IN RADIOLOGY section of *JAMA*, has appointed two senior coordinators for Diagnostic Radiology, **Jack Edeiken, MD,** and **E. Robert Heitzman, Jr, MD,** both outstanding men in the field.

Dr Edeiken, professor of radiology at Jefferson Medical College and chairman of the Department of Radiology, Thomas Jefferson University Hospital, Philadelphia, has concentrated on orthopedic radiology. Author of *Roentgen Diagnosis and Diseases of Bone* (Baltimore, Williams & Wilkins Co, 1967; ed 2, 1973; Spanish ed, 1977) and *Roentgen Atlas of the Hand and Wrist in Systemic Disease* (Baltimore, Williams & Wilkins Co, 1973), Dr Edeiken has also published more than 60 journal articles and syllabi and is co-editor-in-chief of *Skeletal Radiology*. He serves as consultant for radiology journals and as a member of many committees in radiological societies and associations.

Dr Heitzman is director of the Diagnostic Division, Department of Radiology, at the State University of New York Upstate Medical Center, Syracuse. He is an outstanding authority on radiology of chest diseases. He has served on several committees of radiological societies and associations and has held many offices, including the presidency of The Fleischner Society, 1978-1979. Dr Heitzman is an editorial board member of *Investigative Radiology* and *American Journal of Roentgenology* and has published more than 50 articles and many syllabi and exhibits. He is co-editor of *An Atlas of Cross-Sectional Anatomy* (New York, Harper & Row Publishers Inc, 1979).