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## Paleopathology of an Archaic Ossuary at the Lewis Central School Site in Pottawattamie County, Iowa

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This Late Archaic ossuary, approximately 2800 years old, was discovered near Council Bluffs, Iowa in 1975 during earth moving operations that partially destroyed it. The fragile skeletal remains of 25 individuals ranging from childhood to old age were recovered from the undisturbed portion. Slight to moderate arthritic changes were observed in 4 of the 18 adult skeletons and one example of spondylolysis was encountered. There was no unequivocal evidence of dental caries. Abrasion of the teeth was severe, starting soon after the teeth erupted, and progressing to serious dental complications in one-third of the adults over 20 years of age. A similar number of adults were afflicted with periodontal disease. Two teeth of a child between 1 and 2 years of age showed pigmentation suggestive of erythroblastosis fetalis.

INDEX DESCRIPTORS: Iowa archaeology, ossuary, Late Archaic, paleopathology

The Lewis Central School site ossuary (13 PW 5) was located near the southern city limits of Council Bluffs, Iowa, on a terrace-like extension of the foot of the loess bluffs on its northeastern side, overlooking the alluvial plain of the Missouri River to the west. It was discovered by chance in the autumn of 1975 during earth moving operations and was partially destroyed before its nature was suspected. Activity in the immediate area was halted temporarily while efforts to establish its true character were made. Eventually the Office of the State Archaeologist of Iowa became involved in its identification, and shortly thereafter became fully responsible for its investigation.

An archaeological field party carefully excavated the remaining and undisturbed portion of the ossuary in late November, 1975. Removal of skeletal and cultural material to the laboratory was opposed by the Omaha Indians and other Indian leaders who insisted on immediate reburial on the assumption that these were Indian remains. It was finally agreed, however, that the recovered material could be studied to the extent necessary to establish its identity beyond doubt, provided the examinations were completed locally and that all materials that had been recovered were reburied in a decent manner in a local cemetery within a few days after they had been excavated. The single exception that was allowed was a piece of human bone to be sent to a distant laboratory for radiocarbon analysis needed to establish the age of the ossuary.

A field laboratory was provided by Iowa Western Community College, Council Bluffs, Iowa, which permitted a biology laboratory to be converted to that temporary use. As excavation, measurement, and photography of each subdivision of the ossuary was completed, the skeletal and cultural material within the subdivision was removed to the laboratory while work was continued on the remainder of the ossuary. In the laboratory the materials were cleaned, regrouped as recovered from the earth, and broken bones were mended insofar as the limited amount of time available for the project allowed. That time, unfortunately, was very inadequate because the skeletal material was fragile and extensively fragmented.

The cultural context of the ossuary eventually was identified as Late Archaic with a radiocarbon age of  $2815 \pm 80$  years B.P.<sup>1</sup> A few of the skeletons were articulated and flexed. Most were disarticulated, suggesting bundle burials. The collected material represented at least 25 individuals. No skeleton was complete. The dento-facial parts of the skeleton could account for only 23 individuals with certainty. Ages represented ranged from one child slightly less than 2 years old to one male of more than 60 years. Eighteen adults were between 16 and 60 years old. The remaining 5 were children between the ages of 2 and 9 years. Eight of the adults were female and eleven were male.

Obvious pathological changes were limited mainly to dento-alveolar and articular structures. There was no convincing evidence of bone fracture or of overt trauma to bone. One left radius and one right ulna each showed single superficial areas of reactive or hyperplastic bone

suggestive of localized chronic inflammatory lesions of the adjacent soft tissues of undetermined cause. Trauma or infection, or both, are possibilities.

Arthritic changes were observed with certainty in at least 4 of the 18 adults in the series. This was expressed usually as extra irregular masses of bone on the upper and lower margins of vertebral bodies, commonly designated as lipping, particularly in the cervical and lumbar segments of the spinal column. In one instance the arthritic lipping had progressed to fusion, or ankylosis, of the 3rd, 4th and 5th lumbar vertebrae into a single, inflexible unit. In another instance, however, arthritic bone proliferation in its early phase was observed on the greater portion of the margin of the articular surface of the head of a femur. It could not be determined whether this particular bone was associated in life with any of the spinal lesions, but it is quite possible that an individual with marked spinal arthritis had other joints similarly involved.

One 5th lumbar vertebra provided a good example of spondylolysis, in this case, with complete absence of most of the neural arch. Often when it is observed in fairly well preserved skeletons in articulated burials the neural arch may be present but separate from the vertebral body. Trauma to an otherwise normal spine may cause this abnormality, but it is believed that its most frequent occurrence in the 5th lumbar vertebra is caused by the anatomic vulnerability of the neural arch of this bone to compressive or shearing forces generated between the articular processes of the more vertically positioned 4th lumbar vertebra above it and the more obliquely oriented sacrum below. In brief, it would seem to be one of the ill effects of human evolution to upright posture, aggravated by degenerative changes in intervertebral discs that permits the vertebrae and their articular processes to become more closely approximated. Although spondylolysis is relatively infrequent, its occurrence increases with age.<sup>2</sup>

In respect to the dento-facial structures, the most notable general conditions were freedom from dental caries and marked attrition of the teeth. In only one tooth, a markedly abraded lower molar, was there any lesion that might be suspected of having been produced by caries. However, its polished surface and the lack of undermining of the margins are not the classical features of a carious lesion. Except for this single equivocal lesion, there were no other suggestions of dental caries. The teeth of all of the adults were abraded to the extent that all occlusal surface enamel and anatomic pattern were obliterated. Evidently, this condition was reached early in the third decade of life. This judgement is supported by an early similar condition in the upper first molar of an individual whose third molars had just erupted but had not yet been abraded, and by a second mandible in which all teeth but the third molars showed advanced attrition while the third molars showed only facets in the cuspal enamel on the right side and exposure of cuspal dentin on the left. Similar advanced attrition was observed in the deciduous teeth of one maxilla in which the first permanent molar was

already in occlusion and showed facets on the cuspal enamel.

This relatively rapid attrition of the teeth ultimately was a source of discomfort for some of the persons in the series in whom the rate at which tooth substance was worn away was faster than the rate at which reparative dentin was formed on the internal walls of the pulp chambers. Eventually the functional pulp chamber, even though it was being reduced in size by reactive dentinogenesis, was overtaken by the external attrition so that the chamber was exposed and the pulp was infected. The sequelae were not only pulpitis, the symptom of which is toothache, but extension of the inflammation throughout the entire pulp and beyond the apex of the tooth root and into the periapical supporting structures, including immediately adjacent alveolar bone. When this stage was reached the offending tooth was also painful to pressure. While periapical abscesses are not necessarily inevitable under such circumstances, persistent chronic periapical inflammatory lesions are the rule, except in rare instances. Relatively insignificant lesions of this type may remain confined within the periapical alveolar bone indefinitely, but in the more active and larger lesions the periapical bone is slowly destroyed so that ultimately the buccal plate of the alveolar process is breached in the vicinity of the root apex. In unusually active periapical inflammations most of the alveolar process surrounding the involved tooth may be destroyed and the tooth lost. In this series of individuals, exposure of the pulp chamber by attrition with the full range of periapical lesions was observed in 6 of 18 adults over 20 years of age, or one-third of them.

In the process of wearing away the crowns of teeth, the habitual jaw movements in some individuals were such as to produce a rather flat, cusplless occlusal plane for the entire dental arch. In others, the masticatory habits tended to produce occlusal surfaces on the molars that were slanted either buccally or lingually, with a slant in the opposite direction in the opposing jaw. These slanting occlusal planes tended to be accentuated with the passage of time. As this process continued, the usually exerted masticatory forces directed occlusally, slowly acquired a lateral component that increased with time and attrition. Since the supporting structures of the teeth are not anatomically qualified to resist lateral forces of this intensity, these lateral forces became slowly destructive to the periodontium. The pathologic effects observed in the jaws were tipping of the teeth, usually lingually, resorption of alveolar bone support, and in extreme instances, protrusion of molar root apices through the buccal plate of the alveolar process. The extremes of this condition was seen in only two jaws.

Resorption of the alveolar process as the result of chronic periodontitis was noted in 7 of the 18 adult mandibles. In three of these instances dental calculus was still adherent to the necks of the teeth. Most of the evidence of periodontitis consisted of early resorption of the internal surface of the alveolar margin, particularly around the third molars, or of resorption of the crest of the interdental septum of the alveolar process, or of uniform loss of height of the alveolar process in the molar region.

Of the 80 loose teeth included in the recovered material only 5 were noteworthy. One showed a small enamel pearl on the root near the cervix. Another was an example of fusion of deciduous upper central and lateral incisors. The third tooth, an upper central incisor with a fully formed root, showed enamel hypoplasia with two prominent grooves surrounding the crown. It is tempting to speculate upon the possible metabolic crises that might have produced this result but the availability of the other central incisor, had it shown similar abnormality, would have made a strong case for its systemic origin.

The 4th and 5th loose teeth were noteworthy indeed. They were an almost completely formed deciduous upper lateral incisor and the not quite completely formed crown of a permanent upper first molar. The entire substance of these two teeth was stained a bluish purple. It appeared to be the result of endogenous pigmentation. This peculiar color, which characterized both teeth, indicated that they probably were from the same child who was perhaps 1 to 2 years of age at the time

of death. If the pigmentation was actually endogenous in origin, as gross inspection suggested, then it probably was the result of some form of hemolytic anemia.<sup>3</sup> The disorder most likely to be associated with a sustained hemolysis in this age group is erythroblastosis fetalis. In the variety of this disease known as icterus gravis, the prognosis is variable and the afflicted child may recover and attain a normal life span. However, the infant with icterus gravis who recovers usually passes the danger period of red blood cell destruction in about two months after birth so that the excess blood cell pigment in the plasma usually stains only the deciduous teeth that are rapidly forming at that time. The two teeth in question, nevertheless, were in formation during a period of almost two years of postnatal life and even the most recent increments of the molar crown were stained. It seems evident that the icteric phase of the patient's disease must have been closer to 2 years than to 2 months.

Knowledge of the physical ills of these early Americans gained through this necessarily much-too-hurried examination increases our sympathetic understanding of some of the unpleasant facts of life which they were forced to endure. But this fragmentary knowledge of some of the diseases that afflicted these people does not necessarily end with an attempted listing of their inferred miseries. Some of their diseases serve as indicators of their cultural characteristics.

Not much can be said, in this latter respect, about the lesions of arthritis other than to indicate that these early American Indians, like ourselves, probably found it very uncomfortable to live with. It is a very old disease in vertebrate history.<sup>4</sup> The facts of the presence or absence of dento-alveolar disease, however, are much more useful in that they reflect certain aspects of subsistence and food preparation. The conspicuous freedom from dental caries that was observed in these remains may be explained by the absence of a significantly cariogenic diet, or by the anticariogenic effect of an abrasive diet, or both.<sup>5</sup> Studies have shown that the early North American Indians suffered from dental caries to a degree roughly proportional to their habitual dependence upon plant foods.<sup>6,7,8</sup> This would tend to suggest that the people represented by the remains in this ossuary subsisted mainly on foods provided by the wild animal and plant life available in their environment. But the dietary situation must have been more complex than this simple explanation suggests because the teeth of the buffalo-eating Sioux showed relatively mild abrasion after long use<sup>6</sup> whereas the teeth of the ossuary skeletons showed marked attrition at an earlier age as well as almost complete freedom from caries.

The advanced attrition of the teeth of all of the persons in this series who lived past early childhood approaches in severity that observed in the skeletons from another Archaic site, Indian Knoll<sup>6</sup>, in Kentucky. It is possible that grit in food pulverized on milling stones or exfoliated from hot cooking stones, as well as mastication of coarse, abrasive food substances may have caused this condition.<sup>7</sup> These methods of food preparation were known to have been employed by Archaic peoples who did not make pottery.

The two stained teeth that are believed to have been from a child with erythroblastosis fetalis raise questions about the different genetic origins of its parents because it is likely that they were of dissimilar blood types. It is possible that its mother was either Rh negative or belonged to blood group O. The child may have been either Rh positive or belonged to blood group A or B or AB, which trait, of course, was inherited from the father. But if the child, born of a multiparous Rh negative mother, had been Rh positive this antigenic blood factor probably would have provoked an antibody response in the mother sufficiently strong to end the life of the child shortly after birth as a result of severe destruction of its red blood cells. This child lived almost two years, however, a fact that tends to implicate the ABO blood groups in the genesis of this child's disease because the effects of ABO group incompatibilities are more variable<sup>9</sup> and sometimes less lethal. Another argument against the Rh factor as causative in this presumed

case of erythroblastosis fetalis is that all full blooded American Indians, both male and female, are believed to be Rh positive and, hence, immunologically compatible on this basis. In American Indian groups that have been tested, blood group O is the most frequently encountered, followed in decreasing order by groups A and B and AB, the latter two groups tending to occur infrequently.<sup>10</sup> Thus, on the basis of chance, there seems greater likelihood that the father of the child with the stained teeth might have belonged to blood group A. On the other hand, had he belonged to the much rarer blood group B or AB, the ultimate effect on the child could have been the same. In any event, these unusual teeth seem to indicate that the population group from which they were derived was not genetically homogeneous.

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