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# OLD WORLD ORIGINS OF SYPHILIS IN NEW YORK

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The presence of Yaws and the time-course for its replacement by syphilis were investigated in upper New York State to assess Yaws as the original North American treponemal disease and to document the timing of the first origins of syphilis in this region. Skeletal remains from Frontenac Island [2000 years before present (ybp)], Sackett (700-1000 ybp), Tram (1570-1590), and Powerhouse (1635-1655) sites were evaluated. Periosteal reaction was found in Frontenac Island, Sackett and Tram site skeletons, in contrast to the characteristic changes of syphilis in 12% from the Powerhouse site. Treponemal disease has clearly existed for at least 2000 years in what became upstate New York. The characteristics of the initial treponemal disease (Yaws) remained essentially unchanged for most of that time, at least through 1590. Subsequent to European contact, the character of the treponemal disease changed drastically, and syphilis was identified. The implication is that European contact resulted in significant change in disease expression.

**Key words:** Paleopathology, bejel, yaws, syphilis.

*La presencia de pian y el tiempo transcurrido para su reemplazo por sífilis fueron investigados en el estado de Nueva York, a objeto de evaluar el pián como la treponematosis original de Norteamérica y documentar el surgimiento de la sífilis en la región. Los restos esqueletales de los sitios de la Isla Frontenac, Sackett, Tram y Powerhouse fueron evaluados. La reacción periostal fue encontrada en los esqueletos de la Isla de Frontenac, Sackett y Tram, en contraste a los cambios característicos de sífilis en el 12% del sitio Powerhouse. La enfermedad ha existido claramente por 2000 años en el estado de Nueva York. Las características de la enfermedad inicial (pián) permanecieron esencialmente iguales la mayor parte del tiempo, por los menos hasta 1590. Subsecuente al contacto europeo, el carácter de la treponematosis cambió drásticamente, y la sífilis fue identificada. La implicación es que el contacto europeo resultó en un cambio significativo en la expresión de la enfermedad.*

***Palabras claves:*** *Paleopatología, bejel, yaws, sifilis.*

Three main theories have been advanced hypothesizing the origins of syphilis (Cockburn 1963; Harrison 1958a,b; Rothschild and Martin 1993). Fueling this controversy has been lack of distinguishing characteristics among the treponematoses (Fieldsteel 1983; Hudson 1958a,b; Noordhoek et al. 1990; Norris 1993). Recent development of reproducible distinguishing criteria (Rothschild and Rothschild 1995) allows new insights. Validation of these criteria in over 100 skeletal populations (Hershkovitz et al. 1995; Rothschild et al. 1995a; Rothschild and Rothschild 1996a,b,c).

If Yaws was the parent treponemal disorder, as suggested by Hudson (Hudson 1958a,b), then Yaws would be documentable in pre-contact populations. If the source of syphilis were extrinsic to the resident population(s), syphilis would only be demonstrable subsequent to contact

with pertinent other groups. As population migrations to North America occurred subsequent to origins of Yaws in Africa (Rothschild et al. 1995b), Yaws would be expected to be the original treponemal disorder in North America (if the transition to syphilis postdates that migration).

Report of a possible case of pre-Columbian treponematosis (Elting and Starna 1984) raised the possibility that the nature of treponemal disease could be clarified in New York state. Snows (1995a) in depth population analysis, addressing Mohawk Iroquois sites in New York, raised the possibility of substantial skeletal populations for analysis. Snows study, however, was based on archaeologic site, not skeletal analysis. Further review failed to identify availability of appropriate New York skeletal populations, other than those analyzed in this study. The Ft. Plain (Galligan 2) Mohawk site (Snow 1995b) was destroyed in a fire. Sand Hill, a multicomponent prehistoric to historic site, provides inadequate time segregation for time impact studies, so inherent to the treponemal question. The other remaining Mohawk site, Rice Woods (1580-1614), no longer appears available for study. Thus, only Seneca sites seemed amenable to evaluation at this time.

Presence of Yaws and time-course for replacement by syphilis were investigated in upper New York state to validate the Yaws (as the original North American treponemal disease) hypothesis and to identify the juxtaposition of events responsible for the denouement of syphilis.

## Methods

Skeletal remains from the collections of the Rochester Museum and Science Center were subjected to visual examination of all articular and cortical surfaces to identify all occurrences of articular and peri-articular bony alterations throughout each skeleton, specify the types of bony alterations at each occurrence, and map the distribution of occurrences in each skeleton. Metaphyseal and diaphyseal cortical and periosteal alterations were especially assessed. All variation from normal smooth cortical surfaces was noted. Treponemal disease was specifically recognized on the basis of periosteal reaction and osteitis (Freedman and Meschan 1943; Gann 1901; Goff 1967; Hunt and Johnson 1923; Moss and Biegelow 1922; Rothschild and Heathcote 1993; Rothschild and Rothschild 1995).

Analysis of nature and extent of skull involvement (Hackett 1976; Steinbock 1976) does not distinguish among the treponemal diseases. Qualitative post-cranial variation, however, was reported by Hackett (1963, 1967) and Hudson (1958). Hackett (1976) recognized the biased nature of his study of isolated bones from medical museum collections, and of skull collections, and did not attempt to distinguish among the varieties. Our agreement with Hacketts perspective (of difficulty of making a diagnosis on the basis of a single bone) led to quantitative analysis in well defined populations, and to the criteria (Rothschild and Rothschild 1995a,b) applied in this study. Interesting, Hackett (1976) applied the term "non-specific" periostitis in a very specific matter. He used it to designate isolated bones, whose appearance were not absolutely diagnostic of disease. Attempt to relate specific periosteal reactions to specific diseases perhaps is fundamental to the confusion. This, however is a misconception. Variety of periosteal reaction (observed in a single isolated bone) is not disease-specific. General periosteal thickening, single or multilaminated periosteal layers and spiculated periosteal reaction are quite different in morphology, yet are all found in thyroid acropachy (Resnick and Niwayama 1988; Rothschild and Martin 1993; Rothschild

and Yoon 1982). Indeed, thickening, single and multilaminated periosteal reaction, and spicu lated periosteal reaction are found in all bone-affecting forms of treponemal disease (Rothschild and Rothschild 1995a; Rothschild et al. 1995a). While variety of periosteal reaction lacks specificity, the pattern is specific.

The designation "non-specific periosteal reaction" appears no longer pertinent when population studies are pursued (Rothschild and Rothschild 1995a). Our agreement with Hacketts perspective (of difficulty of making a diagnosis on the basis of a single bone) led to quantitative analysis in well defined populations, and to the criteria (Rothschild and Rothschild 1995a,b) applied in this study. Following Hacketts (1976) suggestion, criteria for distinguishing among the treponemal diseases were established by examination of populations with unequivocal disease (Rothschild and Heathcote 1993; Rothschild and Rothschild 1995a).

The major premise was recognition of non-traumatic periosteal reaction, distinguished from focal cortical bumps, secondary to local trauma and from "shelves" which Hackett (1976) related to venous ulcers. The periosteal reaction (as observed in isolated bones), is not specific, with exception of extent of remodeling of sabre lesions. While examination of isolated bones with periosteal reaction is otherwise without specificity, the pattern is highly specific (Rothschild and Martin 1993; Rothschild and Rothschild 1995a,b; 1996a,b,c; Rothschild et al. 1995). The osseous reaction to treponemal infection, although reproducible for each variety, is not uniform among them (Rothschild and Rothschild 1995a,b). Examination of population frequency, demography, character, and skeletal distribution of osseous treponemal impact provides clear, reproducible clues to the identity of the underlying treponemal infection (Rothschild and Rothschild 1994, 1995). Syphilis is a low population frequency disorder (2-12%), with limited distribution (median number of bone groups affected = 2). It occasionally produces a sabre shin reaction, but usually has remodeling which is usually so complete as to preclude recognition of any surface evidence of periosteal reaction. Evidence of osseous involvement in children is very rare. Yaws is a more generalized (median number of bone groups affected = 4), high population frequency disorder (21-33%). It frequently affects the hands and feet and commonly produces bone lesions in subadults. Bejel is a high population frequency (25-40%), with limited distribution (median number of bone groups affected = 2). It frequently produces the sabre shin reaction, but only very rarely produces recognizable osseous changes in the hands and feet. Contrasted with the sabre shin reaction in syphilis, that is Yaws and Bejel is invariably associated with surface evidence of periosteal reaction.

Skeletal remains (Table 1) of 63 individuals (15 sub-adults) from the Frontenac Island, New York site (Ritchie, 1945), dated as 2000 years before present (ybp) were evaluated. The site has good preservation, but long bones, were minimally represented in almost one-third and hand and foot bones in almost half. Skeletal remains of 11 individuals (0 sub-adults) from the Sackett site (Ritchie 1936), dated at 700-1000 ybp were evaluated. The site has good preservation, but hand and foot bones were minimally represented in more than half. Skeletal remains of 47 individuals (5 sub-adult) from the Tram site (Wray et al. 1991), dated as utilized between 1570 and 1590, were evaluated. The site has good preservation, but long bones, hand and foot bones were minimally represented in 20%. Skeletal remains of 25 individuals (8 subadults) from the Powerhouse site (Wray et al. 1991), dated at utilized from 1635 to 1655, were evaluated. The site has good preservation.

Table I: Characteristics of Treponemal Disease in the New World Contrasted with Documented Syphilis and Yaws

| | Yaws* | Frontenac | Sackett | Tram | Syphilis* | Powerhouse |
|---|---|---|---|---|---|---|
| Youth Affected | yes | yes | *** | yes | no | no |
| Sabre shin without periostitis | no | no | no | no | *** | yes |
| Flattening without periostitis | no | no | no | no | yes | yes |
| Unilateral tibial involvement | no | no | no | no | yes | yes |
| Average number of bone groups affected > or = to 3 | yes | yes | yes | yes | no | no |
| Hand or foot commonly affected | yes | ** | ** | yes | no | no |
| Frequency perspectives Percent of at risk population affected | 33% | 38% | 27% | 24% | 5% | 12% |
| Sabre shin | 33% | 36% | 33% | 20% | 4% | 0% |
| Average number of bone groups affected | 4.0% | 3.1% | 3.0% | 3.0% | 2.0% | 1.9% |
| Median number of bone groups affected | 4 | 3 | 3 | 3 | 2 | 2 |

* Derived from reference Rothschild and Rothschild (1994a)
** Fragmentary nature of skeletal remain precludes evaluation of this parameter
*** Not present, but inadequate numbers to rule out

While findings in some of the populations in this article have been previously reported (Wray et al. 1991), the examiner(s) have learned much about pathology in the interim. This is probably also the explantation for the discrepency with Pfeiffers (1977:50) observations. While her 1977 perspective of Frontenac Island skeletons was of only one instance of infracranial "non-traumatic pathology," spondyloarthropathy were subsequently recognized in 4% of skeletons (Rothschild and Woods 1992). We are all on a learning curve. Progress along that learning curve

led to revision of initial impressions and the data confidently presented in this study.

The comparison sample for syphilis comprised one hundred and thirty five individuals selected from the 2906 skeleton Todd Collection on the basis of autopsy diagnosis of syphilis (Rothschild and Rothschild 1995). The comparison sample for Yaws comprised 40 individuals from the Gognga Gun Beach Locale (Guam) dated at 500 years before present (Rothschild and Heathcote 1993). Yaws was the only treponemal disease present in Guam prior to 1668, when it was reported in the logs of the first ships to make landfall (Baker and Armelagos 1988; Heathcote 1991; Howells 1973; Stewart and Spoehr 1952).

## Results

Periosteal reaction, characteristic of treponemal disease, was present in 24-38% of Frontenac Island, Sackett and Tram site skeletons, in contrast to only 12% of those from the Powerhouse site (Fisher exact test, $p = 0.0025$). The average number of bone groups affected in the Frontenac Island, Sackett, and Tram sites was 3, contrasted with only 2 in the Powerhouse site. Tibial involvement in the Frontenac Island, Sackett, and Tram sites was invariably bilateral, whereas unilateral involvement was noted in the Powerhouse site. Tibial sabre shins were invariably associated with visible periosteal reaction/changes in the Frontenac Island, Sackett, and Tram sites, in contrast with full remodeling in the Powerhouse site.

Tibial periostitis compatible with Yaws was identified in the Frontenac Island site in 4 individuals with unfused epiphyses. The demographics of involvement in these and other individuals from the site are delineated in Table 1, as is the presence or absence of sentinal (Rothschild and Rothschild 1995a) characteristics. As absence of disease in subadults in the Sackett and Tram sites reflects absence of any subadults in the Sackett site and presence of only 5 individuals in the Tram site, statistical significance (Fisher exact test) is not achieved.

Periostitis compatible with syphilis was found in 3 individuals in the Powerhouse site. All were adult. There was no evidence of periosteal involvement in any individual with unfused epiphyses. The demographics of involvement in the site are delineated in Table 1. Hand and/or foot involvement was commonly present in the Tram site and absent in the Powerhouse site. Absence of hand or foot involvement in the Frontenac Island and Sackett sites does not achieve statistical significance (Fisher exact test) because of limited hand/foot material from those sites.

Diagnosis (as to specific treponematosis) is based upon absence of "contradictory" findings and presence of supportative findings. All supportative findings are not required for diagnosis, but "contradictory" findings would eliminate a specific diagnosis from consideration. Presence of hands and feet in the Frontenac Island and Sacket site populations would provide additional information, but its absence does not alter the diagnostic perspective. So too, inadequate subadult representation does not compromise diagnosis of Yaws in the Sackett site population.

## Discussion

Treponemal disease has clearly existed for at least 2000 years in what became upstate New York. The original disease present was diagnosed as Yaws, on the basis of population sample characteristics (Rothschild and

Heathcote 1993; Rothschild and Rothschild 1995). The characteristics of this treponemal disease remained essentially unchanged at least 2000 years, through 1590. Yaws, thus was documented consistently in a series of sites in the time prior to significant contact with Europeans. Etienne Brule travelled in Seneca territory starting in 1615 (Stewart 1970). Fort Nassau was established by the Dutch in 1614, followed by Fort Orange (near Albany) in 1624 (Bradley 1987) and both became centers for Seneca trading (Stewart 1970). Thus, subsequent to European contact (Bradley, 1987; Stewart 1970), the character of the treponemal disease changed drastically. The high population penetrance (20-40%) disease (Yaws), with frequent childhood and metapodial expression, was replaced by a low population frequency (2-12%) disorder (syphilis), which tends to spare metapodial joints and which is extremely rarely observed in children (Rothschild and Rothschild 1995; 1996a, 1997). The implication is that European contact resulted in significant change in disease expression. Whether indirect impact (change in dress or habitation), resulting in eradication of Yaws, or direct sexual transmission are responsible for this apparent European-contact change is subject for future investigation.

Patterns of distribution distinguish the treponemoses from thyroid acropachy and hypertrophic osteoarthropathy. The latter is a predominantly distal diaphyseal disorder, which seldom affects the femur or humerus (Goff 1967; Resnick and Niwayama 1988). This contrasts with predominantly hand and foot involvement in thyroid acropachy, lower extremities in venous stasis, and mandible, clavicle, scapula, and ribs in infantile cortical hyperostosis (Caffreys disease) and the prominent enthesial reaction in hypervitaminosis A and fluorosis (Goff 1967; Resnick and Niwayama 1988; Rothschild and Martin 1993; Rothschild and Rothschild 1995)

As syphilis and Yaws appear mutually exclusive and as syphilis only replaced Yaws in Guam subsequent to elimination of Yaws (Lewis 1975), the suggestion is that some event in the 1590-1640 interval was responsible for the eradication of Yaws. The obvious consideration is a direct or indirect effect of European contact.

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