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The Science behind Pre-Columbian Evidence of Syphilis in Europe: Research by Documentary

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Abstract

This article discusses the presentation of scientific finding via documentary and absent the process of peer-review. We use, as an example, PBS's *Syphilis Enigma*, in which researchers presented novel evidence concerning the origin of syphilis that had never been reviewed by other scientists. These "findings" then entered the world of peer-reviewed literature through citations of the documentary itself or material associated with the documentary. Here, we demonstrate that the case for pre-Columbian syphilis in Europe that was made in the documentary does not withstand scientific scrutiny. We also situate this example from paleopathology within a larger trend of "science by documentary" or "science by press conference," in which researchers seek to bypass the peer review process by presenting unvetted findings directly to the public.

The foundation of science is the peer review process.¹ Within this process, research findings are vetted by peers who are experts in the field and can attest to the scientific worthiness of the authors' assertions. Following publication in a scholarly venue, the popular press may disseminate the results of this research. Popular documentaries and press conferences following publication are two outlets that have gained a prominent role in realizing the obligation of scholars to bring their research to the public. However, a new genre of research has emerged that circumvents the process of peer review. In "research by documentary," controversial results are not initially presented to colleagues in the field for evaluation but are, instead, directly presented to the public without having undergone the peer review process. These unevaluated results then become part of the body of peer reviewed research via reviews, news stories, or through personal communications. While this process has been called a "deviation" by some, it is becoming an increasingly common practice.²

Here, we present a few prominent examples of this phenomenon that come from a controversial problem in paleopathology. The origin and antiquity of syphilis represents one of the greatest historico-scientific questions in the history of medicine. Did Columbus and his crew bring syphilis from the New World to the Old World in 1493, as suggested by the timing of the first reported epidemic in Europe just years after their return (see Fig. 1)?^{3–5} Or, did syphilis originate in the Old World, simply going unrecognized until the early 15th century or perhaps noticeably increasing in prevalence or virulence at this time?^{6–8} These rival theories regarding the origin of syphilis in the Old World have been named the Columbian and pre-Columbian hypotheses, respectively. In this article, we focus on *The Syphilis Enigma*, a documentary in the Public Broadcasting Service (PBS) series, *Secrets of the Dead*,⁹ which presents the controversy surrounding the Columbian hypothesis, as well as a more recent British Broadcasting Company (BBC) documentary, *Pompeii: Life and Death in a Roman Town*, which reports the discovery of pre-Columbian European skeletons bearing evidence of syphilis in ancient Rome.¹⁰ We discuss discrepancies between the findings described to the media and the results that have filtered out into the research community over time, and we conclude with an overview of the origin and antiquity of syphilis in Europe in the light of data that have been presented in the peer reviewed literature.

The Syphilis Enigma documentary pits one of the authors (G.J.A.) against another paleopathologist, Charlotte Roberts, as the protagonists in a debate wherein Roberts presents evidence on the origins of syphilis that, according to the documentary's blurb, "turns the prevailing Columbian theory on its head." The key to Roberts's argument is skeletal material recovered from the Hull Magistrate's Court site in Hull, England, a friary founded in AD 1316–1317 and occupied until 1539, which she states reveals indisputable evidence of syphilis. The narrator in the documentary specifies that the skeletons in question have been radiocarbon dated to AD 1300–1450. To further support her position, Roberts cites ancillary skeletal data from Pompeii and Metaponto, Italy, which she argues provides additional evidence for syphilis appearing in Europe before 1492. All of this evidence is presented authoritatively, even though it has never been evaluated in the peer review process. In addition to the documentary, *The Syphilis Enigma* is also represented by a PBS website reaffirming the material presented in the film, as well as making it available to a wider audience which may never have seen the film.¹¹ Finally, an additional—and more balanced—treatment of the subject can be found in Hugh Miller's¹² chapter on the syphilis enigma in the companion book, *The Secrets of the Dead*.

The documentary primarily focuses on four skeletons from the Hull friary that are reported to bear indisputable evidence of syphilis. Roberts gives a detailed description of Skeleton 1216, a young adult male who bears lesions that are undeniably due to some form of treponemal disease (i.e., syphilis, yaws or bejel). However, the other three skeletons Roberts mentions as having "syphilis-like" lesions (i.e., skeletons 805, 932, 1121) are not described in any depth in the documentary. (Syphilis and the other treponematoses manifest on the skeleton in diverse ways, but characteristically cause *caries sicca* lesions, a series of confluent pits and star-like radial scars on the skull, along with thickening of the skull, as well as periosteal reactions, or deposition of new bone on the exterior surface of a bone, accompanied by surface pitting and thickening of the bones).^{13–15} Similarly, the documentary's claim that 60% of the other 245 skeletons recovered at the site have lesions indicative of syphilis on their postcrania is mentioned only briefly, and none of this evidence is presented for evaluation. In fact, this high reported prevalence of "syphilis-like" lesions, which would substantially bolster the pre-Columbian hypothesis, has yet to be discussed in a peer reviewed publication on the friary site. Moreover, an unpublished draft report¹⁶ which provides the only available comprehensive discussion of skeletal remains from the site, notes only several disarticulated long bones bearing "treponemal-like lesions" and a solitary skull with *caries sicca*.^{16:50} The date ranges for these finds are not indicated. While approximately 70% of adult skeletons from the site do indeed have lesions on their postcrania, Holst and colleagues^{16: 44} correctly note that the type of lesions observed—periosteal reactions—are very common in ancient skeletons. New bone can be deposited in response to irritation and inflammation, among other triggers, and thus periosteal reactions can be caused by a number of different conditions, ranging from treponemal disease and varicose veins to trauma and tuberculosis.^{17–20} Periosteal reactions caused by treponemal disease characteristically result in thickening or expansion of the affected bones (especially when accompanied by osteitis, the deposition of new bone within the marrow cavity of a bone), with localized enlargements (nodes) and shallow pitting on their exterior surfaces. However, because of the wide range of possible causes of periosteal reactions, this lesion is by no means diagnostic of syphilis.^{21,22}

Skeleton 1216's key importance in the documentary is primarily due to the pre-Columbian dates presented for it. The radiocarbon date reported is in the range of AD 1300–1430. The film also presents a cogent case for dendrochronological dating of skeleton 1216, based on Baltic forest wood taken from coffins found at the site. Wood from these coffins gives a date of AD 1340–1369. The documentary's narrator interprets these dates as evidence of syphilis

in Europe 150 years before the return of Columbus from the New World. But how solid is the evidence underlying these dates?

Let us start with the radiocarbon dates. Skeleton 1216 has been radiocarbon dated twice, once in 2000 and again in 2003. We presented both dates to the public for the first time in 2011 as personal communications in a critical review of reported cases of Old World, pre-Columbian treponemal disease.²³ The first radiocarbon date for skeleton 1216 gives a range of AD 1310–1435; the second, a range of AD 1428–1611. These two dates, performed on the same skeleton, give ranges that barely overlap one another; this difference is most likely due to error inherent in the process of AMS dating that is poorly understood and consequently not included when generating 95% confidence intervals.^{see 23} The latter date is consistent with an individual who contracted syphilis after 1493. Moreover, neither of these date ranges takes into account an important source of uncertainty in radiocarbon dating: the marine reservoir effect. In *The Syphilis Enigma*, Roberts is quoted as saying that since Hull was a port city, many of its residents may have consumed a lot of fish, “and that high marine content in the diet can affect the accuracy of the radiocarbon results.” That is, a diet high in marine or lacustrine content can generate radiocarbon dates for the organism that can be hundreds or even thousands of years older than its actual age.²⁴ This effect is caused by delayed exchange rates between atmospheric CO₂ and ocean biocarbonate and the dilution effect caused by the mixing of surface waters with upwelling deep water that contains ‘old carbon’.^{25–27} To correct for this effect, the relative proportion of marine content in the organism’s diet is assessed, typically using $\delta^{13}\text{C}$ values, as marine foods are typically enriched in $\delta^{13}\text{C}$ (relative to terrestrial protein sources).^{28,29} Correcting for the effect is complicated, as $\delta^{13}\text{C}$ values yield only rough approximations of marine dietary content; e.g.,^{30,31,32} however, a very conservative adjustment suggests that approximately 30% of Skeleton 1216’s diet came from marine sources.²³ Corrections for the marine reservoir effect yield adjusted date ranges of AD 1408–1611, for the first date, and AD 1492–1657 for the second, more recent date. Both corrected dates include a span of over 100 years after the return of Columbus and the first recorded syphilis epidemic in Europe.

The dendrochronological dating of the coffins is also reported to place the affected individuals in the pre-Columbian period. In the documentary, the stratigraphic relationship of the dated coffins to skeleton 1216 or to the other three skeletons is never clearly presented. Personal communications in 2007 with the archaeologist in charge of the excavations at the Hull friary site, David Evans, however, have firmly contradicted any close stratigraphic—and thus temporal—relationship between 1216 and these medieval coffins; problematically, a description of the archaeology and stratigraphy of the site has never been published. Nonetheless, in the documentary, the ambiguity of the stratigraphic relationship is never mentioned, which reinforces in the viewer’s mind a pre-Columbian date for skeleton 1216.

What of the three other skeletons reported to show “syphilis like” and to have definite pre-Columbian dates? According to the *Secrets of the Dead* web site, as of 2002,¹¹ Charlotte Roberts was working to obtain new radiocarbon dates on these three skeletons as well as some of the other bones recovered from the Hull friary site with “treponemal-like” lesions. Indeed, in 2003, Roberts obtained radiocarbon dates for two of the individuals, skeletons 932 and 1121. Independent evaluation of these cases show that neither of them exhibit lesions diagnostic of syphilis or of another treponemal disease, and the new radiocarbon dates for the skeletons, when corrected for their consumption of marine resources and the marine effect, stretch to 150 years after Columbus’s return: AD 1478–1647 and 1497–1671, respectively.²³

Thus, none of the ‘evidence’ reported in this widely viewed documentary holds up under scrutiny. However, even though it became progressively more clear that the evidence was faulty after the documentary aired, updated and correct information was never presented to either the scientific community or the public because there was no article to retract. As the research discussed in the documentary had never been published, it took years for the authors of this article—and other interested researchers—to obtain and assess information that should have been easily accessible in a peer reviewed journal article. Unfortunately, during this time period, the conclusions presented in the documentary began to enter the body of peer reviewed literature, unquestioned. How did this happen?

In von Hunnius et al.’s³³ article “Histological Identification of Syphilis in Pre-Columbian England,” in the *American Journal of Physical Anthropology*, a date range of AD 1300–1450 was reported for the four skeletons from the Hull friary site. Von Hunnius and colleagues state that the range was based on radiocarbon dating, dendrochronology of the aforementioned coffins, and stratigraphy. However, no specific radiocarbon date ranges were provided, and the article also lacked all of the other information traditionally provided for such dates, including laboratory IDs, uncalibrated dates, and $\delta^{13}\text{C}$ values. While they note that the radiocarbon dates alone cannot confirm a pre-Columbian date for the skeletons, given the potential that the dates may incorporate uncertainty from the marine effect, von Hunnius *et al* state that stratigraphy and dendrochronology place the skeletons firmly within the pre-Columbian period.³³ It should be noted that several years before this article was published, the second radiocarbon date for skeleton 1216, which substantially overlapped the post-Columbian time period even when uncorrected for the marine reservoir effect, had already been obtained by one of the authors (C.A.R.). This second date, however, is not mentioned. Though this article reiterates the information stated in the documentary—that archaeological evidence places the four skeletons in the pre-Columbian time period—David Evans, the source of the personal communication cited by von Hunnius and colleagues, later stated that this was not the case, resulting in a he-said, she-said situation that could not easily be resolved due to the lack of a peer reviewed publication detailing the dating and archaeological context of these skeletons. Thus, information from *The Syphilis Enigma* appeared almost word-for-word in a peer reviewed publication. This occurred even though it had never itself been evaluated by peer review and had, by the time of publication, been shown to be questionable by a researcher involved in both works (C.A.R.). In this form, it could now be easily cited in respectable, peer reviewed publications—and this is exactly what has happened, as von Hunnius et al.³³ has been cited fourteen times by the time of this writing (according to Google Scholar), and other researchers have now used the spurious dates given for the Hull friary site as the basis of their own analyses.^{e.g., 34}

Another example of how the suspect findings in *The Syphilis Enigma* have become part of the peer reviewed literature is through the process of review. In an article in the peer reviewed journal *Sexually Transmitted Infections*, Morton and Rashid³⁵ reported on the PBS documentary and posed the question: *The syphilis enigma: the riddle resolved?* While they were careful to use neutral language such as “It is claimed,” they ultimately accepted the evidence that the 245 skeletons from the Hull friary site represented evidence compatible with pre-Columbian treponemal disease. At the time of this writing, this article has been cited twenty times, according to Google Scholar.

The skeletons from Hull were not the only evidence in favor of the pre-Columbian hypothesis presented in *The Syphilis Enigma*, however. Skeletal material reported to bear evidence of syphilis from Metaponto, Italy, a large Greek colony dated to 580–250 BC, was also discussed. The evidence from Metaponto has been presented by Maciej and Renata Henneberg in archaeological site reports, *The New York Times*, *National Geographic Exploration* (a non-peer reviewed periodical published by National Geographic), and Dutour

et al.'s³ influential conference proceedings volume on Old World, pre-Columbian syphilis, *The Origin of Syphilis in Europe: Before or After 1493?* However, never having been peer reviewed, there is no way to objectively evaluate their findings. In *The Syphilis Enigma*, they state that there is indisputable evidence of syphilis in skeletal remains found at Metaponto and Pompeii. They are, however, more cautious in print. For instance, in an evaluation of the health of residents of Metaponto, Henneberg et al.^{36:458} cautiously state the evidence for syphilis within the populace is:

Based on macroscopic observations and analysis of frequency distributions of symptoms that in isolation are not indisputably pathognomonic for treponematosi. The ultimate proof would have to be provided by a direct immunochemical test. Such a test, however, is unlikely to succeed, since in tertiary treponematosi, when bone changes occur, very little antigen is present and antibody levels are lowered. These facts leave little hope of success when coupled with the expected partial decomposition of antigens and antibodies after death and during the centuries in the soil.

Two years later, in their contribution to Dutour et al.'s volume, the Hennebergs,³⁷ state that skeletal evidence for syphilis at Metaponto includes such features as thickening of diploë, a layer of bone in the cranial vault, bowed 'saber-shin' tibia, and cranial lesions. However, as they acknowledge, the poor preservation of the remains prevent definitive diagnosis (of *caries sicca*) in the cases of cranial thickening,³⁸ and the other types of lesions are not specific to syphilis. The authors also note the presence of dental stigmata on several of the teeth recovered from the site, including enamel hypoplastic defects and 'mulberry molars,' which they regard as evidence for congenital syphilis. Skeletal evidence of congenital syphilis is widely regarded as a confirmation that syphilis existed in a given region and time period,³⁹ and it is critical to the argument for Old World, pre-Columbian syphilis.^{40,41} However, the Hennebergs do not acknowledge that neither enamel hypoplastic defects nor mulberry molars are diagnostic of congenital syphilis. Hypoplastic defects are produced by incomplete development of the tooth enamel and can be due to any number of causes. Mulberry molars, also produced by incomplete development, have an irregular formation of the cusps, which makes the chewing surface resemble a mulberry. A rigorous analysis by Hillson et al.⁴² has demonstrated that mulberry molars overlap morphologically with several forms of enamel hypoplastic defects. As a whole range of growth disturbing conditions can cause these defects, mulberry molars are thus not diagnostic of the disease either.

Unfortunately, disregard for the peer review process by researchers delving into the origin of syphilis did not end with *The Syphilis Enigma*. In late 2010, a documentary named *Pompeii: Life and Death in a Roman Town* aired on the BBC.¹⁰ During the film, the discovery of a pair of adolescent twins recovered from the site displaying what are "almost certainly the signs of congenital syphilis" was reported.⁴³ Unfortunately, the nature of these signs was not described. However, this announcement echoed the earlier suggestion made in *The Syphilis Enigma* and elsewhere by the Hennebergs,⁴⁴ that there was abundant evidence, in the form of skeletal lesions, written documents, and artistic depictions, for cultural practices in Pompeii that supported the spread of sexually transmitted infections, including syphilis. Given the fact that a peer reviewed paleopathological survey of 250 skeletons from the nearby city of Herculaneum, preserved by the same volcanic eruption, found no evidence of treponemal disease,⁴⁵ the discoveries reported at Pompeii certainly deserve a healthy dose of scrutiny. Whether the vague findings reported in *Pompeii: Life and Death in a Roman Town* will also make their way into the peer reviewed literature, having never undergone review themselves, remains to be seen.

The examples above show that one danger associated with "science by documentary" is that faulty research can be presented as valid. Another, less obvious risk is that the interpretation

of both the problem and the results are placed in the hands of media professionals aiming for high ratings rather than researchers seeking clarity. Thus, ambiguous evidence and intentionally polarizing presentations intersect to muddy real scientific debates. For example, the narrator of *The Syphilis Enigma* states that the Columbian hypothesis “blames” “dirty American Indian women” for the transmission of syphilis to the Old World. Similarly, Mary Lucas Powell states in the film that “for almost 500 years, native North Americans have been blamed for giving the world syphilis and by implication, accused of sexual immorality.” Certainly, debates on the origins of sexually transmitted infections are morally loaded, and powerful groups often blame more vulnerable populations for spreading diseases such as syphilis (see Fig. 2).^{46–48} However, the tone of the debate over the origins and antiquity of syphilis shifted some years ago, when the pre-Columbian hypothesis faced a new, modified Columbian hypothesis: one that better fit available evidence and also happened to absolve the New World of being the birthplace of syphilis.^{see 49,50} Skeletal evidence from many pre-Columbian sites in the New World indicates a high prevalence of treponemal disease paired with a low age of infection and an apparent absence of lesions attributable to congenital syphilis;⁵ this suggests a non-venereal form of the disease, similar to modern-day yaws or bejel and one not passed through the placenta (i.e., a congenital variant), was present. Due to differences in climate, clothing, and sexual practices, Renaissance Europe would have represented a very different environment than that present in Hispaniola, the location of Columbus’s first arrival in the New World. The subspecies of the bacterium responsible for syphilis, *T. pallidum* subsp. *pallidum*, would have thus encountered a very new set of selective pressures upon arrival in the Old World. Perhaps it was exposure to this novel host environment that resulted in the birth of the *T. pallidum* subspecies that causes syphilis. Thus, in this modified Columbian Hypothesis, Columbus and his crew could have transported a New World, non-venereal treponemal infection to Europe upon their return, which, once there, could have responded to dramatically different selection pressures with a new, sexual, transmission strategy. Today, neither of the major competing hypotheses regarding the origin of syphilis assign blame or make moral judgments upon Native Americans, as was suggested by *The Syphilis Enigma*.

Given the conflicting information presented by these documentaries and our discussion here, the reader may wonder which hypothesis the peer reviewed evidence supports, if any. It is clear that treponemal disease existed in the pre-Columbian New World; unmistakable skeletal lesions are found at sites throughout the Americas, and they stretch back for thousands of years.^{4,5} In contrast, though a number of cases of pre-Columbian, Old World treponemal disease have been reported, all seem to have either a problematic diagnosis or date.²³ To illustrate, let us consider only radiocarbon-dated cases of treponemal disease. In the New World, there are few such cases, both because the antiquity of the disease is less controversial there and because radiocarbon dating and other types of destructive analysis of indigenous human remains is often not possible or advisable because of NAGPRA (Native American Graves Protection and Repatriation Act) and other social, ethical, and political concerns.^{51–54} Nonetheless, those cases that do exhibit definitive, diagnostic signs of treponemal disease and have been radiocarbon dated to the pre-Columbian period confirm that the disease existed in the Americas for millennia (see Fig. 3). Radiocarbon dates are available for many more of the reported Old World cases, since invasive sampling is often permitted in these regions. Once radiocarbon dates are adjusted for the marine reservoir effect, all cases of Old World treponemal disease with a definitive diagnosis overlap 1493, the date of Columbus’s return (see Fig. 3). These results, the lack of treponemal lesions in huge, pre-Columbian European and North African samples, and the sudden appearance of characteristic lesions in many of the same samples after 1493,²³ all indicate that treponemal disease existed since ancient times in the New World, but appeared in Europe and North Africa only after Columbus’s return voyage.

This area of investigation is still open however, and it is probable that novel molecular data will help close the book on the history of syphilis. Recently, for example, it was possible to obtain phylogeographic data to help elucidate the evolutionary trajectory of this family of bacteria by sequencing modern strains of *T. pallidum*, as well as strains of the other subspecies responsible for the non-venereal human diseases yaws and bejel from all over the world. The results, obtained by sequencing twenty-one different genetic regions, suggested that syphilis strains diverged more recently than their non-venereal relatives and that their closest relatives were two yaws-causing strains collected from indigenous inhabitants of Guyana, in South America.^{50,55, but see 56} These results are consistent with the modified Columbian hypothesis described above, and future sequencing efforts are likely to further clarify *T. pallidum*'s shared past with humans.

In conclusion, there has been a blatant disregard for the peer review process in making the case for pre-Columbian syphilis in the Old World. Unfortunately, however, this is not an isolated example of this phenomenon. A cursory survey of important finds in the natural and social sciences suggests that the strategies of “science by documentary” or “by press conference” are often employed, especially to announce highly controversial findings. One strategy results in a complete circumvention of peer review, and direct dissemination of findings to the press and thence to the public. This strategy, used in the reports of pre-Columbian Old World evidence at Metaponto, was also used in 1989, when two chemists from the University of Utah, Stanley Pons and Martin Fleischman, announced by press conference that they had achieved cold fusion. This finding was disseminated to the scientific community only by way of newspaper headings; experiments performed by independent researchers have never replicated their results.⁵⁷ Similarly, this year Kamila Remisova Vesinova and her team of researchers from the Czech Archeological Society reported in a press conference that they had unearthed the remains of an early homosexual man from a site on the outskirts of Prague dated 2900–2500 BCE. Major news publications ran articles with titles such as “Gay caveman discovered”⁵⁸ and “An Ambiguously Gay Caveman Is Your New Media Darling”.⁵⁹ While the story was quickly questioned by fellow scientists, the damage in terms of dissemination of questionable findings had already been done.⁶⁰

In another form of “science by documentary”, which was implemented for the cases from the Hull friary, press releases or documentaries are issued before peer reviewed results are made available. This strategy is exemplified by reporting of the Clovis Comet theory, which proposes that a devastating cosmic collision about 13 kya caused the demise of the Clovis people and the extinction of much of North America’s megafauna.⁶¹ The theory was initially presented in a press conference while the original paper was still under review at *Proceedings of the National Academy of Sciences*, which published the evidence five months later. The NOVA program on PBS which aired two years later failed to consider evidence which disputed the comet theory. While the theory still enjoys media and popular support, it has since received profound critique from other scholars in the field⁶² and is widely regarded as discredited.^{62–64}

As in all scientific fields, in order to resolve the controversy over the origin and antiquity of syphilis in the Old World, there is a strong need for adherence to standard practice in scientific publication and the increased publication of relevant evidence in peer reviewed journals. As Park⁶⁵ discusses in a short article in *The Chronicle of Higher Education*, when researchers attempt to circumvent peer review by presenting their results directly to the public, it generally suggests that the presented findings are unlikely to stand up to scrutiny by scientific experts. Slow but steady progress is being made toward the goal of fleshing out the history of the fascinating pathogen, *Treponema pallidum*, that causes syphilis. Flawed

documentaries can no longer stand as one of the primary sources of information on the current evidence for Old World, pre-Columbian syphilis or any other scientific issue.

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Figure 1.

This woodcut, “The French Disease,” is dated to August 1st 1496 and is attributed to Albrecht Dürer. It represents one of the earliest known depictions of the disease now recognized as syphilis. The illustration was originally accompanied by a text commentary written by Theodoricus Ulsenius, city physician of Nuremberg, remarking on the recent emergence of the syphilis epidemic in Europe and attributing the origins of the new disease to the conjunction of Jupiter, Mars, and Saturn in 1484 (as indicated by the signs of the zodiac above the figure). The close temporal proximity of the production of this illustration to the return of Columbus and his crew provides support for the Columbian Hypothesis.



Figure 2.

This illustration was originally featured in a broadsheet in verse, *De Pestilentiali Scorra siue Mala de Franzos Eulogium*, which was published in September, AD 1496, in Germany, by Sebastian Brant. According to Gilman⁶⁶, the image shows a closed community of syphilitics, three male and one female, being punished by the *flagellum Dei* (the ‘whip of god’) for their sexual transgressions. The arrows emanating from the hands of Jesus function as agents of infection and signify the martyrdom of the victims, who suffer as a consequence of the fall from Eden. Later re-workings of this illustration place more emphasis on the male sufferer, emphasizing that he (and thus men, overall) are the true victims and women, through their sin, are to blame for the illness. The black spots or ‘blatterns’ (e.g., blisters) on their faces symbolize infection with the disease now known as syphilis and are an indicator of moral blight.

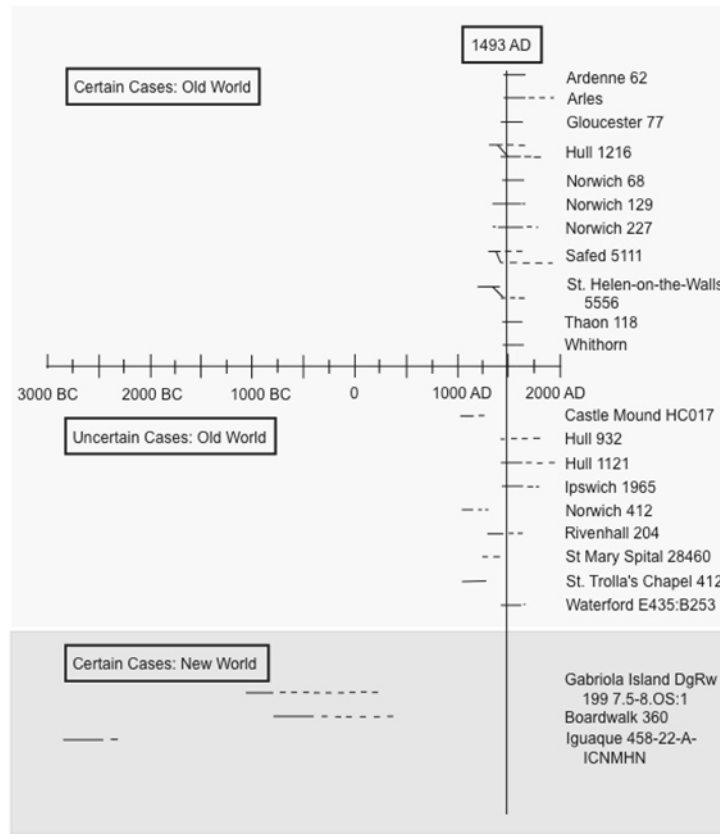


Figure 3. A timeline showing the radiocarbon dates for reported pre-Columbian Old World and New World cases of treponemal disease. This demonstrates that the earliest Old World cases with skeletal lesions that are diagnostic of syphilis or another treponemal disease (e.g., bejel or yaws) cluster tightly around the year AD 1493. This contrasts with reported Old World cases that are not diagnostic of treponemal disease and New World cases with lesions that are diagnostic, which both include specimens that can be securely dated to much older periods. The solid lines represent 95% confidence intervals for the radiocarbon dates, unadjusted for the marine reservoir effect. The dashed lines indicated the range of dates that must be considered after adjusting for the marine effect. Freshwater reservoir effects and some other sources of uncertainty were not incorporated into the adjustments^{see 23}.