LETTER

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REPLY TO MANNING:

Dating of Gordion tree-ring sequence still stands within a year of 745 BC

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We thank Manning (1) for his detailed consideration of our published work but point out that none of the objections raised affects, undermines, or alters our core scientific conclusions. First, the wiggle-match position using IntCal13 was undertaken to demonstrate comparability with previously published results, not to date our annual ^{14}C sequence. Any calibrated result is subject to change if new data are added or if new iterations of the calibration curve (2) or OxCal (3) are used (as evidenced by repeated redating of parts of the Anatolian sequence [Manning et al. (refs. 4–6)]). Second, where our contribution presents something different, (i.e., a temporal anchor for the Gordion sequence), we match annual ^{14}C time series from this material with annual ^{14}C from calendar-dated material from other regions, measured at the same radiocarbon laboratory (to avoid interlaboratory issues) and at a different laboratory (to provide interlaboratory control [Pearson et al. (refs. 7 and 8)]). Large quantities of high-quality data are used to arrive at a fixed range that is not subject to shifts that are part of the calibration process. We stand by our methodology for the χ^2 analysis (see ref. 9, SI appendix, figure S2) as both robust and appropriate to the data but also note that Manning's (1) alternate range would not, in fact, alter our conclusion; the final placement, tested by superposed epoch analysis (SEA), utilizing the annually resolved tree-ring scale, would still be the same. Third, we used Kuniholm et al.'s full Anatolian tree-ring chronology for this analysis (ref. 10, now extended). As noted by Manning (1), this contradicts Manning et al. (6), who questioned the dating of the early part of this chronology, presenting then-new, now-outdated, radiocarbon data. We encourage quality control and adjustments to dendrochronological dating placements when new tree-ring data emerge; however, in this case, removing the segment of the sequence with which Manning takes issue and rerunning the SEA produces a nearly identical outcome. Our final dating is, again, unchanged. Fourth, we recognize the possibility that the <10 ^{14}C year offset between our same-laboratory measurements on Irish and Mediterranean trees could be due to slight growing season differences. Indeed, we have generated a large volume of same-laboratory, multiregional annual ^{14}C [Pearson et al. (refs. 7–9)], to explore factors such as this, specifically recognizing the need for a more precise understanding of the Mediterranean region radiocarbon fluctuation. The annual data published by Pearson et al. (9) are a major contribution in this regard. We would advocate such an approach over an emphasis on regional comparisons with "IntCal" [Manning et al. (refs. 1 and 11)] simply because the IntCal curve, by necessity, includes intermittent small interlaboratory variations and/or site-specific differences and is smoothed across periods of more coarsely resolved data. Finally, we did not attempt to connect a ^{14}C effect ca. 1548 BC with our reported calcium anomaly as Manning posits; rather, we simply noted the feature as worthy of further exploration. We are, nevertheless, grateful for the opportunity to correct a typographical error associated with this point.

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The authors declare no competing interest.

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