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LETTER TO THE EDITOR

The Relation of Dating and Chronology: Comments on Chatters and Hoover (1986) and Butler and Stein (1988)

Butler and Stein (1988) raise an important issue about dating fluvial sequences in the context of Chatters and Hoover's (1986) "Changing Late Holocene Flooding Frequencies on the Columbia River, Washington." We join this discussion, not to contest the specifics of Butler and Stein's critique, with which we are in full agreement, but rather to point out a more general issue. Butler and Stein criticize the conclusions of Chatters and Hoover because they do not report the kind of samples used in radiocarbon determinations on which flood frequency calculations are based, correctly pointing out that carbon derived from trees may be significantly older, by as much as three centuries, than the fluvial deposits the samples are intended to date. The problem may be further compounded if fluvial activity is entraining long dead, perhaps even previously buried, wood. Butler and Stein make some modest suggestions about the kinds of carbon samples appropriate in such situations and the qualifications that such chronologies entail.

The concerns expressed by Butler and Stein are, however, but one superficial expression of a more general issue that affects the use of radiocarbon dating in many archaeological and geological contexts, namely the relation between the sample event, i.e., the event dated, and the target event, i.e., the event about which the chronological conclusions are drawn (Dean, 1978; Dunnell, 1981). The sample event in radiocarbon dating is the isolation of sample carbon from the global reservoir, typically effected in biological carbon by the death of an organism or particular organic structure. Geological and archaeological target events are rarely, if ever, synonymous with the sample event. This lack of agreement requires bridging arguments to link the sample and target events, arguments that are frequently omitted or incompletely developed in the day to day use of radiocarbon dating in archaeological or geological chronology construction. As a result, there is a tendency—exemplified in the Chatters and Hoover paper—to conflate the accuracy, or the relationship of the mean of a set of measurements to the true value, and precision, or the repeatability of a set of measurements, of radiocarbon determinations with the accuracy and precision of the derived chronology. In the radiocarbon case, the accuracy and precision of determinations are rather well understood whereas the accuracy and precision of chronologies derived from these determinations are usually indeterminant at best because of the problem posed by bridging arguments or their absence.

Framing the issue in theoretical rather than empirical terms leads to conclusions different from those reached by Butler and Stein. Even though radiocarbon dating may be the most accurate and precise general method of age determination for the past few tens of thousands of years, it may not be the best choice for the construction of an archaeological or geological chronology in a great many contexts, simply because geological and archaeological questions rarely directly attend carbon isolation events. As in the Chatters and Hoover case, archaeologists and geologists are concerned more frequently with deposition events. In these cases, better *chronology* may result from using a less precise method, the sample

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event for which is either coterminus with or closely linked to the target event. When the questions are depositional, a better choice will frequently be thermoluminescence (TL) dating of the sediments themselves. In TL sediment dating (Wintle and Huntley, 1982; Singhvi and Mejdahl, 1985; Mejdahl, 1986; Berger, 1986), the zeroing event is exposure to sunlight and thus the sample event is the date of burial, an event directly pertinent to the fluvial history investigations pursued by Chatters and Hoover. Although current developments in TL dating, such as the introduction of the related technique of optically stimulated luminescence dating (Huntley *et. al.,* 1985; Smith *et al.,* 1986), promise to improve its precision and accuracy significantly, it is inherently less precise than radiocarbon dating simply because a much larger number of independent variables, each with its own error term, must be measured. The bridging argument problem brings into question the accuracy of derived chronological statements; whereas the principal liability of TL dating in relation to radiocarbon dating is measurement precision. The "best" general solution for chronologies of deposition events may be large suites (to overcome the precision problems of TL dating) of TL dates. But certainly, a cost-efficient approach to such chronologies can be had in the combination of TL and radiocarbon dating. TL dating can supply an empirical basis for evaluating the simultaneity of the isolation event attended by radiocarbon dating and the sedimentological event of interest. When such assessments demonstrate that the assumption of simultaneity is warranted, the technical precision of radiocarbon dating can be transferred to the derived chronology.

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