Dating a Paleoindian Site in the Amazon in Comparison with Clovis Cuture

Anna Roosevelt *et al.* (*1*) present important new data relative to the peopling of the New World. The radiocarbon ages from stratum 17 indicate that subsistence, based on plant gathering, occurred in Amazonia penecontemporaneously with big-game hunting by Paleoindians of the Great Plains. However, this finding does not necessarily indicate that "a distinct cultural tradition contemporary with the Clovis tradition" (*1*, p. 381) existed at the Pedra Pintada site.

Of the 56 radiocarbon samples described in the article (*1*), the 25 on specific seeds are the best material for accurate age determination because each represents a single year of growth. If these radiocarbon ages, in radiocarbon years before present (^{14}C yr B.P.), are grouped stratigraphically instead one of these is from the base of stratum 17.

As an alternative interpretation of the older ages, I suggest that they may represent seeds that were deposited in the cave by natural processes. Whereas Roosevelt *et al.* state that "[t]here is no prehuman biological material that could have mixed with the cultural remains" (*1*, p. 381), they offer no evidence of this. They state that "[d]isturbance and preservation in the dry sandy soil diminished with depth" and that the Paleoindian deposit contained only "one burrow" (*1*, p. 376). It is not uncommon to have evidence of bioturbation obliterated with depth as overlying strata protect and compact lower strata.

If the human occupation of the cave started approximately at 10,500 ^{14}C yr B.P., there remains nearly a millennium for pro-

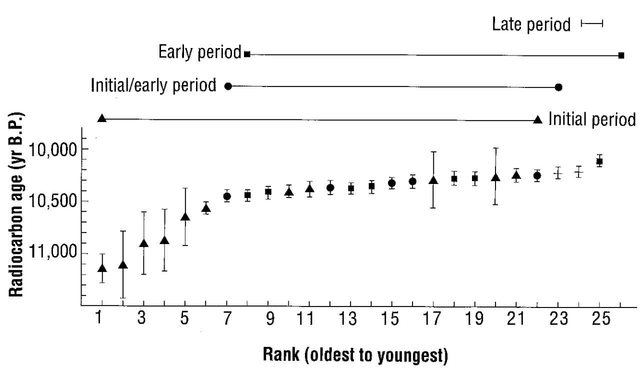

Fig. 1. Radiocarbon dating of seeds found at the Monte Alegre site does not distinguish cultural periods. Upper scales show archaeological periods from oldest to youngest ^{14}C sample in each group.

of by excavated area (by unit), one finds little difference in the averages for each group if the values with standard deviations (sigmas) of more than 80 years are omitted from the averages, that is, the Initial Period is 10,410 ± ~65, the Initial/Early Period is 10,350 ± ~65, the Early Period is 10,330 ± ~50, and the Late Period is 10,220 ± ~50 (*2*).

By plotting the seed radiocarbon ages in order of decreasing age and indexed as to cultural period (Fig. 1), it is readily apparent that, except for five ages with large sigma values, the cultural periods cannot be distinguished by radiocarbon dating. The main occupation, in stratum 17, occurred between 10,500 and 10,200 ^{14}C yr B.P. The mixing of seeds of such a narrow age range across all of the cultural periods within stratum 17 suggests that there has been significant bioturbation. The five oldest ages with large sigmas overlap at one sigma (Fig. 1) and average 10.970 ± ~250. Only two are in excess of 11,000 rybp and therefore within the Clovis age range, and only genitors of Monte Alegre Paleoindians to adapt to foraging in tropical forests in their progression from North America to South America (*3*). Fluted point finds in Central America and the El Inga–type fluted points from Ecuador and elsewhere in South America are compatible with this model.

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1. A. C. Roosevelt *et al.*, *Science* **272**, 373 (1996).
2. For precise averages, see comment by R. E. Reanier.
3. Recent evaluation of Clovis radiocarbon ages places the earliest Clovis age at 11,500 B.P. [R. E. Taylor, C. V. Haynes Jr., M. Stuiver, *Antiquity* **70**, 515 (1996)].

9 May 1996; 13 January 1997

The suite of ^{14}C dates from the important Brazilian Paleoindian site studied by Roosevelt *et al.* (*1*) does not support their conclusion that Clovis (*2*) and Amazonian Paleoindians were contemporaneous. Roosevelt *et al.* assigned 37 ^{14}C dates to cultural periods (Fig. 1) that they established independently by means of changes in stratigraphy and lithic raw material [table 3 in (*1*)]. Multiple dates are available for each of the cultural periods (except the Middle period, which lacks dates), and it is possible to test the hypothesis that dates from a given cultural period are statistically the same (*3*, *4*). This hypothesis cannot be rejected at the $\alpha = 0.05$ level of significance for any except the Initial period (Table 1). For these periods, weighted means of the ^{14}C dates are estimates of their true ^{14}C ages (Fig. 1) (*3*). Exclusion of the oldest date from the Initial period (Fig. 1, date 1) reduces differences among Initial period dates to statistically insignificant levels (Table 1). This oldest ^{14}C date, 11,145 ± 135 yr B.P. [table 3 in (*1*)]—a conventional date with a relatively small standard deviation—prevents homogeneity within the Initial period and seems to provide strongest support for the contemporaneity of the Amazonian Paleoindians and Clovis. However, inspection of other dates from the same provenience unit [table 3 in (*1*)] reveals that a high-precision AMS date was run on a second sample of the same material, carbonized seeds of the palm *Attalea microcarpa*. This date, 10,392 ± 78 yr B.P. (Fig. 1, date 9), 750 years younger, is consistent with other high-precision AMS dates from the Initial period and other periods as well, and casts substantial doubt on the validity of the date 11,145 yr B.P.

The dating of the cultural periods performed by Roosevelt *et al.*—with the Initial period spanning ~11,200 to ~10,500 yr B.P., the Early period ~10,500 to ~10,200 yr B.P., the Middle period ~10,200 to ~10,100 yr B.P., and the Late period ~10,100 to ~9800 yr B.P.—also is not supported by the ^{14}C evidence, which shows substantial overlap among dates from all dated cultural periods (Fig. 1). If the seven lower precision conventional dates (Fig. 1) are excluded from the analysis, then the remaining 30 AMS dates for the site as a whole (including five from the Initial

Table 1. Tests of within-group ^{14}C date contemporaneity (*6*), where T' is the test statistic, DF is degrees of freedom, and P is the statistical significance.

Group	T'	DF	P
Initial period	38.53	11	0.00006
Initial period*	16.49	10	0.086
Initial/Early period	3.50	7	0.835
Early period	15.71	13	0.265
Late period	1.91	2	0.385
All AMS dates	33.21	29	0.269

*Excluding date 1.

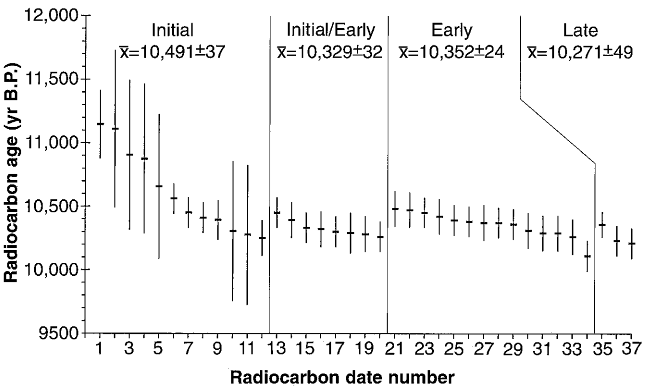

Fig. 1. Radiocarbon dates from Caverna da Pedra Pintada [table 3 in (*1*)]. Dates on humates, which were tests for contamination, are excluded. Dates 1 through 5, 10, and 11 are conventional dates, others are accelerator mass spectrometry (AMS) dates. Bars are $\pm 2\sigma$ ranges based on errors stated in (*1*). Dates are ordered oldest to youngest within periods. No dates were reported from the Middle period, and the Initial/Early group was combined in the article (*1*). Weighted mean ages ($\bar{x}$) for periods include all nonhumate dates and were calculated according to equations (6) and (8) of (*3*). Exclusion of conventional dates from the Initial period results in a mean age of 10,420 ± 41 yr B.P.

period), are statistically indistinguishable (Table 1) (*5*). Weighted mean ages for the periods (Fig. 1) suggest an approximately 300-year-long Paleoindian presence at the site between ~10,500 and ~10,200 yr B.P., with only slight differences in age between periods. On the basis of present ^{14}C evidence from Caverna da Pedra Pintada, the earliest Amazonian Paleoindians appear to be not contemporaneous with the earliest Clovis Paleoindians, but to be at least 1000 years younger (*2*), which would provide sufficient time for the former to have been derived from the latter, or from still earlier South American cultures (see A. Gibbons' News & Comment article, 28 Feb., p. 1256).

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1. A. C. Roosevelt *et al.*, *Science* **272**, 373 (1996); all dates in this comment are given in uncalibrated ^{14}C years before A.D. 1950 (yr B.P.).
2. In midcontinental North America, Clovis dates between 11,500 and 10,900 ^{14}C yr B.P. [R. E. Taylor, C. V. Haynes Jr., M. Stuiver, *Antiquity* **70**, 515 (1996).
3. G. K. Ward and S. R. Wilson, *Archaeometry* **20**, 19 (1978).
4. The absence of high-precision tree-ring calibration of the ^{14}C time scale for ^{14}C ages older than ~10,000 B.P. precludes direct assessment of date contemporaneity caused by short-term fluctuations in Late Glacial concentrations of atmospheric ^{14}C [(*2*); I. Hajdas, S. D. Ivy-Ochs, G. Bonani, *Radiocarbon* **37**, 75 (1995)].
5. In a recent letter, A. R. Roosevelt [*Science* **274**, 1823 (1996)] concluded that these 30 AMS dates were significantly different. Her analysis evidently used Ward and Wilson's Case I (*3*), which is applicable to multiple dates from a single object and does not take calibration curve uncertainty into account. For situations like that at Caverna da Pedra Pintada, where there are multiple dates on different samples from several stratigraphic units, Ward and Wilson's Case II (*6*) is applicable.
6. Tests follow Case II of (*3*) using the test statistic

$$T' = \sum_{i=1}^{n} (A_i - A_p)^2/S_i^2$$

where A_i is the ith ^{14}C date, A_p is the pooled mean of the dates, and S_i^2 is a variance estimate for the ith date that includes estimates of both ^{14}C measurement and calibration curve uncertainty. Under the null hypothesis of equal dates, T' has a chi-square distribution with $n - 1$ degrees of freedom (DF). Calculations were facilitated by the program CALIB (revision 3.0.3C) of M. Stuiver and P. Reimer [*Radiocarbon* **35**, 215 (1993)].

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Roosevelt *et al.* (*1*) do not provide sound chronological placement for a type of stemmed projectile point (yet unnamed) found widely throughout South America. They state that radiocarbon dates from the Pedra Pintada shelter support a 11,000 yr B.P. chronological placement for these typologically distinctive points with barb-like shoulders and contracting stems. Nevertheless, contextual evidence from other South American sites indicates that these points are early to mid-Holocene in age, and not associated with Late Pleistocene Paleoindian occupations.

The two stemmed points in figure 1 of the article (*1*) were recovered from the middle Tapajos River area south of the Amazon. The fragmentary biface specimens found at the Pedra Pintada excavation [figure 6, A to C, in (*1*)] bear no resemblance to the Tapajos River projectile points [figure 1 in (*1*)]. Stemmed points do not appear to be present within the Pedra Pintada site. Assignment of these two points to their assemblage based on debitage and general lithic technology, rather than the presence of the point type itself, is not justified. The lithic techniques noted by Roosevelt *et al.* as diagnostic of the Pedra Pintada Paleoindian (and upper Paleolithic) assemblages are typical of many North and South American Archaic assemblages.

The same two points [figure 1 in (*1*)] were described in detail in an article published 20 years earlier by M. Simoes (*2*). Projectile points, with distinctive barbed shoulders (Roosevelt *et al.*'s "wings") and contracting stems have been found in Colombia (*3*), Venezuela (*4*), Guyana (*5*), and southern Brasil (*6*). Points with comparable shoulder and stem configuration are also found in Peru and Ecuador (for example, Paijan and El Inga Long Stemmed types). Available evidence clearly supports a Holocene/Archaic age for them, not a Late Pleistocene/Paleoindian age as advocated by Roosevelt *et al.*

South of the Amazon, stemmed points with barbed shoulders are common in preceramic Vinitu phase assemblages along the Rio Parana. In light of pedological context and comparative relations with dated assemblages, Chmyz initially estimated their age at between 8,000 and 7,000 yr B.P. (*6*), an assessment later supported by an 8,000 yr B.P. date from the Rio Paranapanema region (*7*). Artifacts identical to Roosevelt *et al.*'s "limaces" (a term heavily laden with French Paleolithic connotations and thus not appropriate in this context) are also common in the Vinitu and later mid-Holocene Pirajui phase, where they are called plano-convex scrapers. They are not exclusive Late Pleistocene/Paleoindian artifacts, as implied by Roosevelt *et al.* In the Lagoa Santa region, Hurt recovered a similar point from between two strata with radiocarbon dates of 9,028 ± 120 B.P. and 9,720 ± 128 yr B.P. in the Cerca Grande Rock Shelter #6 (*8*). The two stemmed points I recovered [both were well flaked and thin, not "thick and percussion flaked," as noted by Roosevelt *et al.* (*1*, p. 375)] from the Culebra site on the Orinoco River were stratified above an earlier (though still Holocene) preceramic component (*9*). More recently, a radiocarbon date of 6,000 yr B.P. was obtained from the Middle Magdalena River area in Colombia from a context containing stemmed points with barbed shoulders (*10*). If the dates given by Roosevelt *et al.* were correct, they would have to relate to a complex, lacking points, comparable to that described by Prous from Minas Gerais several years ago (*11*).

What relevance does the Pedra Pintada site have for Clovis? Most Paleoindian specialists do not consider Clovis subsistence to be strictly a "big-game" adaptation. Clovis subsistence was a broad spectrum economy, varying with geographic locale, that included plants, fish, and possibly avian species as well as mammals (*12*). The statement (*1*) that anthropologists did not expect pre-horticultural groups in Amazonia is not appropriate, because the references in question deal with Insular Southeast Asian groups. Meggers (*13*) argued that the lowland tropics must have great time depth to allow for the linguistic diversification notable in the area. Finally, particulate decomposition of the shelter's "friable sandstone" roof and back wall, coupled with high rates of tropical weathering, argue strongly against preservation of painted rock art from 11,000 yr B.P.

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13. B. Meggers, in *Profiles in Cultural Evolution*, A. T. Rambo and K. Gillogly, Eds. (Museum of Anthropology, Univ. of Michigan, Ann Arbor, 1991), pp. 191–215.

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Response: Haynes and Reanier analyze the Monte Alegre dates (*1*) by criteria that Clovis dates (*2*) cannot fulfill. The 1000-year age difference is thus an artifact of a comparison that treats precision, accuracy, means, and context differently for Monte Alegre and Clovis. Comparison of Monte Alegre with North American sites by consistent criteria establishes the contemporaneity of the Monte Alegre culture with the Clovis tradition.

The 11 excavation units at Monte Alegre (*1*), a deposit about 30 cm thick in about 2 m of stratified deposits, produced about 30,000 exotic lithic specimens and 56 ^{14}C assays (not 37, as Reanier states) between 11,145 ± 135 and 10,000 ± 60 yr B.P. The dates' standard errors (SEs) of 50 to 310 years were equal to or less than the "minimum overall band of uncertainty" for late Pleistocene dates (*3*, p. 4).

The majority of the samples ($n = 26$) were cocosoid palm endocarps from shallow hearths and lenses. The fruits had been neatly cracked open for their kernels and burned; none had the marks diagnostic of fruit eaten by fauna (*4*). Eleven samples were wood charcoal, which can have inherent age older than an occupation (*3*, pp. 43–47), but these dated in the range of the seed dates. Nineteen AMS check-dates on humic acids extracted from the seeds and charcoal showed no carbon contamination. Sources of geological carbon were absent, and the sand below the deposit was devoid of natural carbon that could have been dated mistakenly. Disturbances were detectable because of contrast between the dark cultural deposit and pale, culturally sterile deposits above and below. Strata merged in some places as a result of bedrock slope and human activities (Fig. 1), but the only biological intrusions were a burrow, a few insect larvae, and small roots.

Periods and sub-periods were defined by the stratigraphic distribution of lithic raw materials and dated samples [tables 1, 3, and 4 in (*1*)]. Ages comparable to Clovis and the earlier part of Folsom predominated in the initial occupation (Figs. 1 and 2). The four Clovis-age dates from 11,145 ± 135 to 10,875 ± 295 yr B.P. were the only dates from the bottom part of stratum 17 (initial A period). Their time-depth and cultural character are corroborated by the weighted average of the associated thermoluminescence lithic and optically stimulated luminescence sediment dates [table 4 in (*1*)]: 13,865 ± 445 calendar yr B.P., which falls in the calibrated range of Clovis dates (*2*). Twelve Folsom-age dates from 10,655 ± 285 to 10,250 ± 50 yr B.P. came from the middle of stratum 17 (initial B period).

Quartz crystal lithics predominated at the beginning of the initial period, but by its end, chalcedony predominated (Fig. 2). The main occupation, however, took place during the Early through Late periods, represented in middle and upper stratum 17 and in stratum 16. It produced the majority of chalcedony lithics ($n = \sim 27{,}000$) and 40 later Folsom-age dates from 10,470 to 10,000 yr B.P. The ^{14}C dates in initial B through late periods overlapped, but only eight were notably out of stratigraphic order, and none of these were from initial A levels. The ^{14}C dates and lithic frequencies of the different periods and sub-periods were significantly different (X^2 test) (Fig. 1) (*5*).

The weighted average of the beginning occupation's four dates, 11,075 ± 110 yr B.P., falls early among the averages of date series from documented Clovis sites (Fig. 3) [note 4 in (*1*); 6]. The weighted average of initial B dates, 10,420 ± 20 yr B.P., falls in the Folsom range (Fig. 3).

Haynes and Reanier accept only the AMS dates with SEs of 80 years or less, but all Clovis period SEs exceed 80 years (6–8). Similarly, Haynes' procedure of discarding all the cave dates on charcoal or organic acids would eliminate nearly all accepted Clovis and Folsom dates. More than half of Clovis dates are on charcoal, and the rest are on organic acids from plants or bone, which Haynes has characterized as unreliable (*2*, p. 365; 9).

Haynes and Reanier's beginning age for Clovis is based on sites with abundant geological and radiometric evidence for pre-human carbon (*6*, pp. 1825), and all North American dates earlier than 11,000 yr B.P. were run on samples subject to effects from too-old carbon (*6*, p. 1825; *7*). Also, there is no adjustment for the old wood problem of charcoal, the most common Clovis material.

Haynes and Reanier's elimination of the four Clovis-age dates as outliers, and their use of averages for the cave periods, are inconsistent with their age for Clovis, which is based only on outliers (Fig. 3) (*6*, *7*). There are only three dates at ~11,500 yr B.P. from documented Clovis sites, and all have low-precision, problematic materials, or doubtful context. No documented Clovis date series has a weighted average as early as 11,500 yr B.P. Those with SEs comparable to the SEs of the Amazonian Clovis-age dates all have means of less than 11,000 yr B.P. and thus are younger than Haynes' range for Clovis (Fig. 3) (*2*, *6*, *7*). Moreover, although Haynes states that the average of the five earliest cave dates with large errors is 10,970 ± 250 yr B.P. and thus younger than the range of Clovis, this is incorrect. The calculated weighted average of the five cave dates in question is 11,023 ± 100 yr B.P., and thus within his range for Clovis.

Haynes and Reanier also say the Clovis-age cave dates were stratigraphically associated with later dates. However, these were the only dates in their levels. All later dates were from later levels with different lithic frequencies (Figs. 1 and 2) (*1*). Reanier argues that the earliest cave date of 11,145 ± 135 yr B.P. was run on the same sample as a high-precision date of 10,392 ± 78 yr B.P. However, the two dates were run on different palm samples, from different plotted locations, with different lithic associations in unit 5 (Fig. 1). Like the other Clovis-age cave dates, the earliest date was associated with a majority of quartz crystal in the lower part of stratum 17, and the date of 10,392 yr B.P. was associated with a majority of chalcedony in the middle part of that stratum.

Haynes and Reanier delete the early dates (*1*) for various reasons and then argue that the remaining dates overlap so much that they are statistically the same. This "overlap" in their figures is the result of lumping early and late initial dates and the inclusion of a single unit whose initial and early deposits were merged due to sloping bedrock [*1*, table 1, unit 7 in (*1*)]. The results of Reanier's calculations are primarily the product of the large calibration curve error inherent in the period before dendrochronological dating, not of a lack of difference in ^{14}C dates of the periods. Given this imprecision, which Reanier acknowledges, the chi-square test provides a more valid means of evaluating significance (*5*). Also, his deployment of dates violates the criterion of his test (his reference 3), that each group

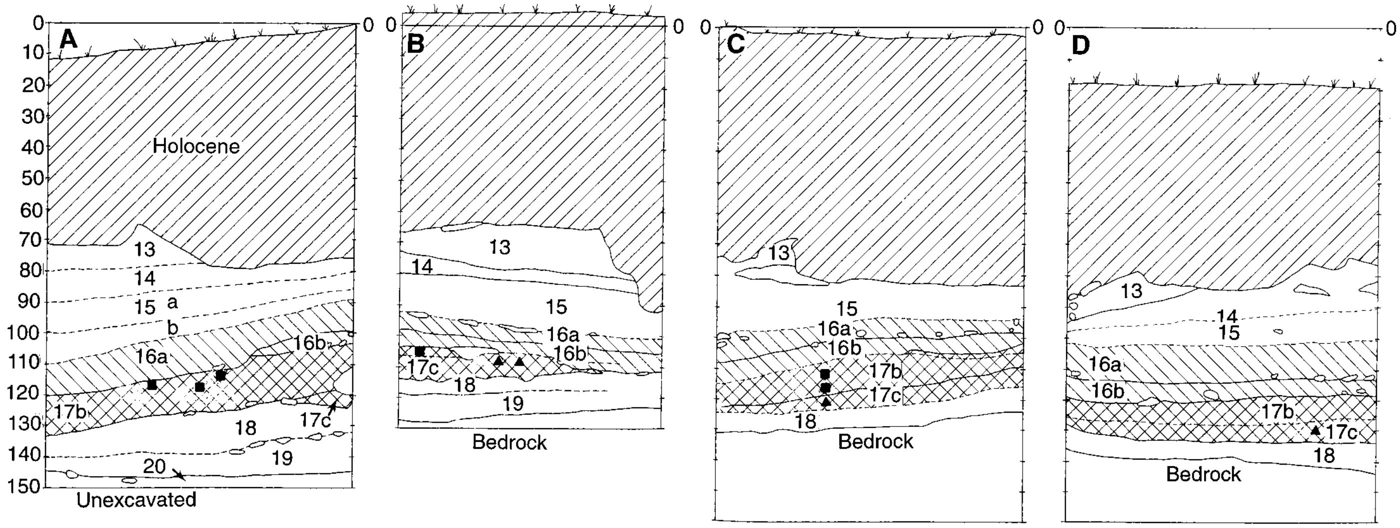

Fig. 1. Monte Alegre initial dates in stratigraphic context. Units are (**A**) 6 South, (**B**) 5 West, (**C**) 2 West, and (**D**) 2 East. ^{14}C values are (left to right or top to bottom) (A) 10,655, 10,305, 10,275; (B) 10,392, 10,875, 11,145; (C) 10,560, 10,450, 11,110; and (D) 10,905. Initial (A) (▲), Initial B (■). Depth in cm.

compared should be from a single component. In stratigraphy, dates, and lithic distributions, initial A and B assemblages represent distinct phases of occupation. The overlap of dates in the cave's later periods is not unique, but a salient characteristic of the contemporary North American Paleoindian dates, and is apparently related to global carbon cycles (*2*).

As for the evidence Haynes cites for the hypothetical Clovis migration, there are no Pleistocene dates for fluted points in lower Central America or northern South America. The only two dated northern South American sites with El Inga fluted points are Holocene; the only two dated Mesoamerican fluted point sites have a single Folsom-age date and five Holocene dates (*9*). All these dates are on humic acid, all have SEs greater than 80 years, and all would be eliminated by Haynes and Reanier's criteria.

The hypothesis of Clovis as progenitor is not supported by its dates. As Haynes himself has written (*10*, p. 96)

> Large standard deviations, inherent ages in wood charcoal dates, and a notoriously poor record for bone dating at most [North American] sites make attempts to construct isochrons of geographic movements (time-space relationships) for a particular cultural complex highly questionable.

Barse's discussion of Monte Alegre contradicts the stratigraphy of lithics and ^{14}C dates there, as well as at other South American sites. We cited the published type definitions for the Lower Amazon triangular bifacial points (*1*, p. 386), which are stemmed or concave-based, often with downturned wings. (Barse prefers the term "barb-like" to "wings," but such functional terms are not appropriate for prehistoric stone tools of unknown function.) Barse cites the same finds as evidence for Holocene age, but only Monte Alegre has been ^{14}C dated [references 2 and 5 (p. 171, plate 36A and p. 10, plate 1) in the comment by Barse].

We documented bifacial triangular forms, stems, refined bifacial reduction flaking, and pressure-flaking among ten bifacial points and point fragments [figure 6 in (*1*)]. Barse says that the bifaces from the cave bear no resemblance to the Tapajos points [figure 1 in (*1*)]. He cites no differences except a supposed lack of stems, but these are present [figures 6A and

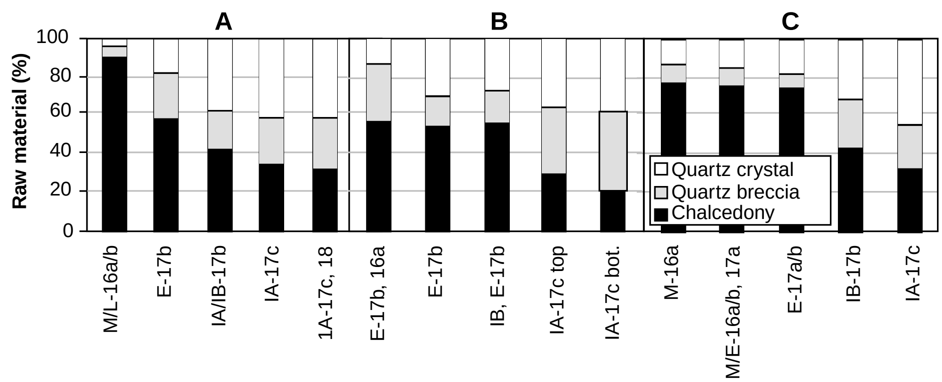

Fig. 2. Lithic histograms by period (**A**) to (**C**) for (A) to (C) in Fig. 1. Frequencies are significantly different within each unit, as well as among all units summed. For the three units illustrated, $n = 3{,}182$; $X^2 = 510$; df, 12; $P < 10^{-9}$; for all nine units, $n = 30{,}420$; $X^2 = 9558.59$; df, 12; $P < 10^{-9}$. See table 1 in (*1*).

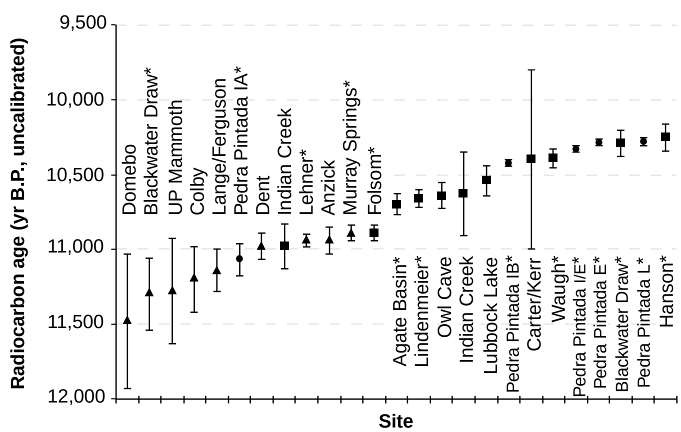

Fig. 3. Radiocarbon dates from Clovis (▲), Folsom (■), and Caverna da Pedra Pintada Paleoindian (●) components. Clovis and Folsom dates are from (*2*, 1996), with the addition of new Waugh dates and deletion of undocumented Aubrey dates. See also note 4 in (*1*) (*6*). Weighted averages of date series (*) calculated using CALIB (*19*) or as done in (*2*, 1996).

6D in (*1*)]. We illustrated the points' stratigraphic placement with other tools and several tens of thousands of bifacial reduction flakes in the levels of the eleven square meters with numerous, exclusively Pleistocene ^{14}C and luminescence dates. The ~65 cm Holocene deposit, above, lacked points and point debris.

The Monte Alegre rock paintings were painted on hard, silicified strata surrounding the friable zones in which the caves are hollowed. Weathering is slight under the rock overhang, and the paintings are sealed by a hard silica layer (*1*, p. 378). Such rock art has survived for up to 11 millennia in rockshelters and caves throughout the tropical lowlands east of the Andes (*1*, p. 374, 383). The dating of the paintings was based on the abundant spatters of paint of the same chemical composition in the Paleoindian strata and the lack of these in post-Pleistocene strata. This association suggested that many of the paintings were Pleistocene, but left open the possibility that some paintings could be younger. However, it lends no support for an exclusively Holocene age.

For prior evidence of chronological contexts for the Lower Amazon lithics and paintings, we cited lithic assemblages with finely flaked, triangular points from eastern South American rock art sites with dates beginning in the late Pleistocene (*1*, pp. 383 and 386). Barse asserts that Pleistocene Brazilian complexes lack bifacial points. He cites Prous, but as we (6) and others have pointed out, Prous has excavated examples of the points from ^{14}C-dated Pleistocene levels at Boquete and other sites (*11*). Barse's other Brazilian references do not show an exclusively Holocene age for the points, either. They do not mention Pleistocene point finds, as they were published later. Moreover, the Vinitu points and limaces are surface finds without ^{14}C dates [reference 8 (pp. 12–16) in the comment by Barse].

Barse also states that we said that the Brazilian points and limaces were exclusively of Pleistocene age, but we wrote, "These assemblages have numerous dates between ~11,500 and 8,000 yr B.P." (*1*, p. 374). As for "limaces," a term to which he objects, this is the term used for the early Brazilian slug-shaped end-scrapers, both in the literature that we cited (*1*, pp. 382–384) and that he cited in note 12 (*16*, *17*). The term "plano-convex scraper," which he prefers, relates to a broad category of tools, not to this diagnostic tool type.

Barse cites his excavations in the Orinoco as support for his chronology, but the only two projectile points he found there were from a site with no ^{14}C dates. He "dated" the points by reference to a distant site that had a single ^{14}C date associated only with three undiagnostic lithic flakes (*13*, p. 1389). We agree with his statement that (*13*, pp. 1389–1390)

The paucity of artifacts from the two preceramic components at the Provincial site makes it difficult to establish good correlation with other South American preceramic phases.

Barse cites the Casitas and Canaima assemblages in Venezuela as evidence for an exclusively Holocene age of the points and limaces, but his sources state that the tools, which were surface finds, probably came into use in the Pleistocene and continued in the Holocene (*14*). (The only excavated, dated point he refers to is a late Holocene ceramic period percussion-flaked specimen unrelated to the preceramic types.) Similarly, Barse's Peruvian and Ecuadorian examples are surface deposits lacking stratigraphically sealed radiocarbon dates. In the case of the Colombian sites, the excavator documents a majority of Pleistocene dates for the points (*15*), not primarily Holocene age.

Barse states that we did not acknowledge that most scholars believe that Paleoindians were broad-spectrum foragers. However, we cited numerous examples of this opinion for South America (*1*, pp. 373–374 and 382–383) and cited Meltzer's synthesis of such evidence from North American sites (*1*, pp. 381 and 384), such as Minnisink.

Finally, Barse's assertion, following Betty Meggers (*16*), that the possibility of early forager occupations in tropical rainforests has been questioned for southeast Asia, but not for Amazonia, conflicts with the literature (*17*, *18*). A recent synthesis concludes, "humans have subsisted in tropical rain forest independently of cultivated foods only in Malaysia" (*18*, p. 281).

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5. S. Bowman, *Radiocarbon Dating* (Univ. California Press/British Museum, Berkeley, CA, 1990), pp. 58–60. The results of the test of significance on the dates were as follows*

Group	X^2	df	*P*
Initial A	1.07	3	0.783
Initial B	14.56	10	0.149
Initial period	48.83	11	0.000001
Initial period†	22.52	10	0.013
Initial/Early	7.13	7	0.416
Early period	30.51	13	0.004
Late period	4.61	2	0.100
All AMS dates	66.26	29	0.000097

*Tests 1 and 2 use all relevant radiocarbon determinations; tests 3 through 8 parallel the groupings in table 1 of the comment by Reanier. †With earliest date excluded.

6. A. C. Roosevelt, *Science* **274**, 1823 (1996).
7. The 11,480 ± 450 yr. B.P. Domebo, date was on an inadequate sample. The Lehner date of 11,470 ± 110 was on charcoal which has inherent age. The three dates from the Clovis type site of Blackwater Draw were on humic acid from non-cultural pond plants. Two (11,630 ± 400 and 11,040 ± 500 yr B.P.), were not from the archaeological deposit, and the date of 11,170 ± 360 was from highly disturbed archaeological strata. See (*2*) and (*6*).
8. The only high-precision dates are two charcoal dates, statistically indistinguishable from the Amazonian high-precision initial dates when 100 years for inherent age is subtracted (*6*).
9. J. B. Bird *et al.*, *Travels and Archaeology in South Chile* (Univ. Iowa Press, Iowa City, IA, 1988), p. 287; M. Massone, *An. Inst. Patagonia* **17**, 47 (1987); W. Mayer-Oakes, *Trans. Am. Philos. Soc.* **76**, 1 (1986).
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11. A. Prous [*J. Soc. Am.* **77**, 77 (1991); *L'Anthropologie* **90**, 257 (1986)] describes limaces and finely flaked triangular bifacial points and bifacial retouching flakes only in the lower levels of the site (1991, pp. 83–97, figure 8).
12. P. I. Schmitz [*J. World Prehist.* **1**, 53 (1987)] describes for the late Pleistocene Uruguai phase (p. 86), "The most diagnostic artifacts are various forms of . . . stemmed bifacial projectile points . . . produced from chalcedony and exhibiting pressure retouch". See also T. Dillehay *et al*. [*ibid.* **6**, 145 (1992)] on the points and limaces from Brazil (pp. 166–167).
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20. Fig. 1 by J. Sliva, Desert Archaeology, Tucson, AZ.

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