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ABSTRACT
No obvious grounds exist for questioning the overall validity of the bristlecone pine (BCP) long chronologies, but there is "play" in some of the crossmatches, imposing an element of flexibility in the interpretation of the data. Not enough is known about processes leading to plural annual rings in BCP for further consideration. A new model, based on non-climatic "overprinting" of incipient tree rings in a time-transgressive manner, shows how less than 1,000 years of real time could have become inflated to over 4,000 years of apparent time. The collateral progression of ^{14}C dates in the BCP chronologies, not nearly as tightly-knit as commonly portrayed, is explicable by a large suddenly-arising and suddenly-ending 1000 year long steady-state emission of "infinitely old" subterranean CO_2.

INTRODUCTION
There are two long BCP (*Pinus longaeva*) chronologies in existence: Methuselah Walk (MWK), from the White Mountains, California allegedly spanning 8,000 years but with older floating segments ([12], and earlier cited works). The 285-core database, used extensively in this study, is archived online [18]. The nearby Campito Mountains (CMP) chronology [27-28], obtained privately, is 5,405 years long and in the process of being deepened and extended [25]. This paper is limited to statistical evaluation of pre-existing BCP ring width measurements (hereafter series). Studies conducted by the author on the BCP wood itself, and with supportive fieldwork in the BCP forest, are discussed in a companion paper [46]. Non-BCP long chronologies cannot be evaluated owing to a general lack of access to the tree ring measurements. However, all of the considerations developed in this paper are highly applicable to all of the other long chronologies owing to the fact that, compared with BCP, they tend to rely on relatively weak statistical crossmatches operating on relatively short overlaps of tree ring sequences.

EVALUATING THE BCP TREE RING MEASUREMENTS
The ring widths of BCP are usually very small (down to one cell in width) and doubts have at times been raised about the objectivity of the ring identification process. Personal experience indicates that the rings in many BCP cores can be visually resolved without difficulty, and the resulting skeleton plots (graphical portrayals of atypically narrow rings) can straightforwardly be matched against the master chronology (composite of many crossmatched series). Of course, cores (or slabs) having too many small rings are tedious to work with and are usually rejected [28]. A sorting of thousands of posted MWK ring width measurements, conducted by the author while assuming an average one cell ring size of 0.03 mm [13], from the inferred 3000 BC—6000 BC time period, indicates that no more than ~5% of them are potentially one cell in size. An expert on BCP, with whom I have worked, suggests that, with experience, about 80% of tiny-ring boundaries can be visually resolved without first checking against the chronology. On this basis, no more than ~1% of MWK ring boundaries are potentially tainted by doubt.

Although the author has crossmatched BCP wood samples visually, a comprehensive evaluation of the actual samples behind the MWK and CMP ring width measurements must await the posting of scanned-in photos of the polished wood samples. For now, it must be noted that, in contrast to most other wood species, non ring-width data in BCP are of relatively little assistance in crossmatching. Personal experience, corroborated by others [37], indicates that BCP latewood shows little year-to-year variation, especially in the narrower rings. Frost-damaged rings occur sporadically in CMP, and are virtually absent in the lower-altitude MWK.

Crossmatching by statistics has the obvious advantage of objectivity. Owing to space limitations, only a few of the analyses performed by the author can be discussed here. Software developed by the University of Arizona Tree Ring Lab [20-21] was used extensively, especially COF12K.EXE (Statistical crossmatching of long series), EDRM (Edit Ring Measurements), FMT (Re-Format), CRONOL (chronology maker). The gleichlaufigkeit (sign changes in tree ring series) were computed by LRM (list ring measurements) for each yearly column of ring width measurements. Some series were graphically printed out for visual examination of the computer-suggested crossmatches. Program ARSTAN was used to list central tendencies of the raw ring width measurements. Finally, Microsoft Excel^R was used to sort and evaluate the extensive output files of COF12K.EXE and ARSTAN. CROSSDATE^R was used to automate segmental skeleton plotting.

DESCRIPTIVE STATISTICS OF BCP TREE RING WIDTHS AND CHRONOLOGY

In terms of sample depth (the number of core or slab samples per year of chronology), MWK rises from 9 to 25 different trees in the first thousand years, drops to 12-16 in the 5th-4th millennium BC, and then falls to only 9-11 in the 3rd millennium BC. After a brief rise to 16 trees/year, the sample depth falls to only 7-11 trees in the 1st and 2nd millennium BC. The sample depth then steadily increases to the present. The CMP has, in terms of publicly released information, a very small pre-2700BC sample depth. In MWK, 22 cores overlapping at least some of the 6,000BC-2000BC interval are over 1000 years long, and there are 53 such cores in the entire 285-member 8,000-year database. In striking contrast to MWK, only 3 cores in CMP are longer than 1,000 years in the pre-1000BC period, for a total of 7 in the entire 121-member 5,405-year database.

In terms of central tendency measures, the range of ring-width values for all MWK and CMP series is, respectively: mean ring width (0.094-0.628mm; 0.195-1.23mm), STD (0.048-0.354; 0.056-0.468), skewness (-0.82-2.603; -0.889-3.107), kurtosis (-0.82-16.33; -0.70-17.39), and mean sensitivity (0.26-0.811; 0.141-0.507). The vast majority of ring width measurements are right skewed (100/121 of CMP cores, and 240/285 of MWK cores). No obvious age-related trends are evident, with the exception of mean sensitivity (the magnitude of the year-to-year variations in ring width) in MWK. Out of the 285 series, the ones with the highest values are all from pre-5000BC, as are the top 6 or 8, and 19 of 26. There is no obvious explanation for this trend.

COMPUTERIZED CROSSMATCHING OF BCP TREE RING SERIES

After detrending of the ring width measurements (elaborated below), the program COF12K.EXE lists the highest statistical correlations for the residuals (tree ring indices). These measure to what extent high values in one tree ring series tend to be associated with high values in the second series (same for small values), at each potential matching points. Owing to the likelihood of fortuitously high crossmatches for short overlaps, series overlaps under 40 years in length are not considered. Thus, for example, if Series (A) is 1000 years old and series (B) is 1500 years old, there are 2420 candidate crossmatching points. Of these, only one (t) value should stand out if the trees grew at the same time and are not complacent (that is, are subject to a strong climatic signal). The remaining 2419 incorrect crossmatch points should yield (t) values that form a normal distribution about (t)=0. Acceptable (t) values for valid crossmatching points must be at least 3.5 [20], or at least 5.0 [32] before one can have confidence of having obtained valid time-synchronous correlations and not chance misfits. Incorrect (t) values greater than about 6.0 are considered infrequent [33], and this is supported by the present analysis. The highest incorrect (t) values encountered, for both MWK and CMP, at 7.8, were considerably smaller than those of most of the inferred correct crossmatch points. The latter are, for MWK, in terms of mean and STD, ($r=0.60\pm0.088$; $t=13.7\pm5.53$), and CMP ($r=0.48\pm0.11$; $t=8.96\pm3.70$), same-tree cores excepted.

DOES THE PROCESSING OF TREE RING WIDTHS GOVERN CROSSMATCHING?

The standard COF12K.EXE settings were used to detrend the raw ring width measurements (to create a stationary series, expressed as tree ring indices) prior to its crossmatch calculations. These processes include: removal of low-frequency variance (decadal and century-scale trends in ring width size) by an automatically-fitted mathematical function (spline), use of an automatic autocorrelation function (ARMA) for removing autocorrelation (the tendency for a given year's growth to have been influenced by the previous year or more), and a log-transform for stabilization of variance (preventing either very small or very large measurements from exerting a disproportionate influence on the statistical computations). To determine if the indicated crossmatch points are an artefact of spline stiffness, repeated crossmatching experiments were performed with the stiffness of the spline as the variable. It was found that, in MWK, and to a lesser extent, CMP, the (t) value was, at most, changed ±1.0. The results agree with those of other studies [44] indicative of differences in processing techniques becoming relatively unimportant as the (t) values increase, and supports the position that BCP in open-canopy stripbark mode is minimally influenced by age-related, nonclimatic growth trends [8].

EVALUATING AUTOCORRELATION OF TREE RING WIDTHS

The first order autocorrelation (one year lag of every series against itself) is low in MWK but high in CMP [27]. To gauge the effect of the ARMA models on BCP series, the MWK and CMP series were alternatively crossmatched with and without the ARMA turned on. For both sets of series, very little difference in the strength and order to (t) values was found for the tested crossmatches. With the exception of a few of the within-CMP chronology crossmatches, second-place crossmatches between the tree-ring series from different trees all had low (t) values, almost always much less than those of the inferred correct crossmatch points. This indicates that any BCP low-order autocorrelation is too weak to obscure the inferred correct crossmatch points.

To test for higher-level autocorrelation, duplicate copies of the longest pre-2000 BC BCP series were crossmatched against themselves using the COF12K.EXE. It was found that, with or without ARMA, the highest (t) values for the highest five lagged self-matches were very low (almost always t<5.0), and the intervals between them were generally unequal to each other. One can therefore conclude that no significant cyclicity exists in the BCP tree ring data.

What about traces of repetitiveness in the 8000-year MWK chronology itself? To help answer this question, a master chronology was made of the 285 cores using the robust mean mode of ring-index averaging built-in into the Program CRONOL. Successive 100-year segments of the chronology were then cut off and crossmatched against the remaining younger portion of the master chronology. The highest matches turned up at 5601-5701BC/3799-3699BC, and again at 5801-5701BC/4793-4693BC, both at (r)=0.45 and (t)=5.0 to 5.1, which is unimpressively low. The procedure was then repeated with 50 year-segment self-matches. Seventeen instances were found where t>=5.0 (and r=0.6 to 0.63), but these crossmatches showed no preferred location and were low for such short overlaps. Clearly, self-repetition of even short blocs of values within the 8000-year MWK is minimal.

To determine if thousand year segments had any preferences for recurrence, CROSSDATE.EXE[R] was used to lag successively younger (by 250 years each time) 1000-year skeleton plot segments against the younger part of the chronology (2200 BC-1979 AD). The points of correlation were all weak, but they tend to fall within the interval 2200 BC-500 BC, in preference to the 500 BC-1979 AD interval, to a statistically significant (p<0.05) extent. This tends to support the position, which is at the heart of the model presented below, that the apparent pre-2200 BC part of the BCP long chronologies is actually an adulterated set of repetitions of BCP trees that had grown not long after 2200 BC.

TESTING THE INTERNAL REPLICATION OF THE ACCEPTED CROSSMATCHES

The internal replication of crossmatches (reciprocity of unique crossmatch points for all series involved; see Fig. 1) is considered further proof for their accuracy. However, several separate instances were found where all three (but no more) series incorrectly crossmatched with each other in a mutually supportive pattern. Figure 1, furthermore, shows two incorrectly (top) and two correctly (bottom) crossmatching series corroborating each other’s match. [Lengths of series and overlaps are to scale. Series identifications are in italics. The lag in years, relative to the correctly dated series, is given in brackets. The (t) values are in boxes.]

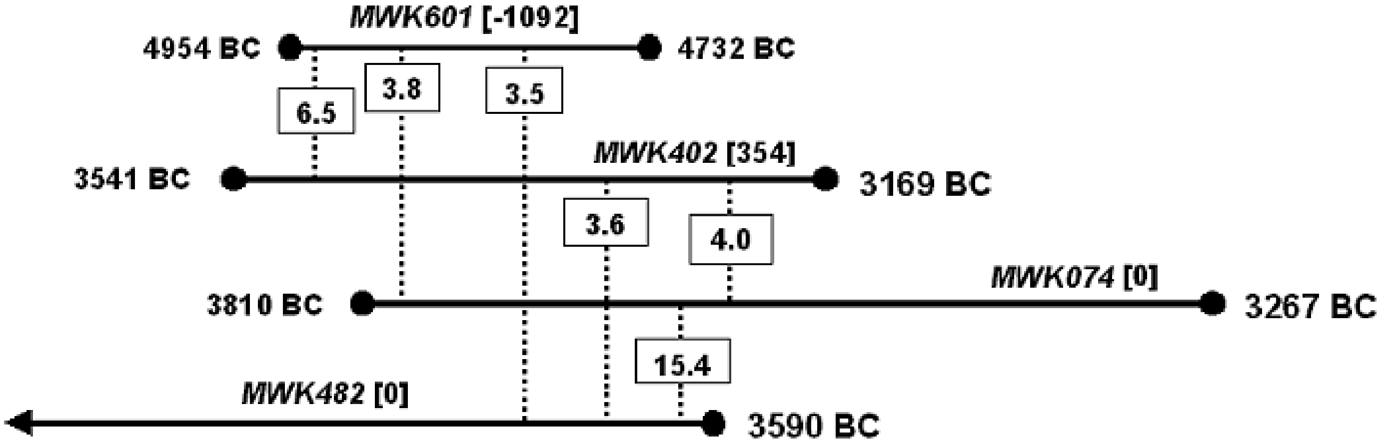

Figure 1. Internally Replicated Assortment of Correctly and Incorrectly Crossmatched Series.

Both the sample depths and (t) values are much inferior to those that are typical of inferred correctly crossmatched ones. However, the full extent of this phenomenon has not been determined owing to the extreme time consumption required by tests of reciprocity involving candidate crossmatches.

What about *individual* series incorrectly crossmatched against a reciprocal set of *many* correctly crossmatched ones? These turn out to be very common, albeit with relatively low (t) values. I found 25 such instances before stopping. For instance, MWK601 (4954BC-4732BC) reciprocally crossmatches with no less than 17 series at the 3508BC-3296BC interval (overlap is 136-223 years, r=0.23-0.4, t=3.5-6.5). Another example is provided by MWK675 (1016BC-743BC), which reciprocally crossmatches, with up to a 274 year overlap, 15 series found in the 3920BC-3646BC interval (r=0.21-0.65, t=3.5-6.2). Obviously, false crossmatches *can* be internally replicated for individual trees against a set of correctly dated ones, and high sample depth is no hindrance to such occurrences. This indicates that a certain fraction of all series in the MWK and CMP chronologies are, at least theoretically, ambiguously situated, and so there is a certain amount of "play" in each chronology.

CROSSMATCHING THE MWK AND CMP MASTER CHRONOLOGIES

It has been asserted [28] that the strong crossmatches between the two master chronologies establish the correctness of each. To test this, the two sets of data were reduced to master chronologies, and the latter two were crossmatched. The highest crossmatch does occur at the 5403 mutual overlap, and is impressively high (r=0.61, t=56.8). However, the second-best fit was not much worse than the first, occurring at a lag of over 4,000 years, and at (r)=0.63 and (t)=50.1. Hence the argument is less than compelling.

There is a common belief that temperature was the primary limiting factor for the higher altitude CMP trees and moisture was the primary limiting factor for the lower altitude MWK trees [27]. Owing to the fact that the MWK and CMP sites are only 16 km from each other, individual cores in both were independently crossmatched against each other en masse. It was found that, while some crossmatches between MWK and inferred contemporaneous CMP series were as high as the stronger MWK-MWK crossmatches (t>15.0), very many others were within the (t) range of false apparent crossmatches (<=7.8). From this it can be concluded that individual variations govern the strength of crossmatches between trees more than do local or climatic site factors. It also means that any alternative model for BCP crossmatches is only moderately constrained by the MWK/CMP corroboration, which on close examination turns out to be disproportionately governed by a relatively small number of trees.

ASSESSING THE TEMPORAL CONTINUITY OF RECIPROCAL CROSSMATCHES

One check for temporal continuity of reciprocity of crossmatching is the gleichlaufigkeit test. When all the MWK series are tabulated, it is common to see all of the many series going from a larger to smaller ring (and vice versa) during particular years. Each such year is called a pointer year, and one pointer year has been computed to occur at a mean of 7.16 years (STD of 5.8 years) during the presumed 8000 years of MWK. As a further check for pointer year concentration, all of the segments in the MWK chronology that have more than 6 tiny rings (pointer years) per 60-year "window" were tabulated. No obvious trend was found in the 8,000 years. In the BC part of CMP, on the other hand, the sample depth is much less than that of MWK, the pointer years are much less frequent, and seldom involve more than 80% of the trees in a given year.

A chain is only as strong as its weakest link. A major hindrance to the construction of long chronologies is any concentration of short overlaps of tree ring series within a short time interval. Whenever this happens, one is uncertain whether the short overlaps constitute genuine crossmatches or fortuitously high-(t) mismatches (for further details, see [4]). To determine to what extent this applies to the BCP chronologies, both were surveyed for turnover. A sliding window of 100 years, lagged every 50 years, was used to quantify the turnover (the number of series beginning and ending within the window). In CMP, a low sample depth in the first 1000 years made this exercise all but meaningless. By contrast, a very disproportionate number of short overlaps were found in MWK at the interval of 4500 BC to 4200 BC, especially at 4420 BC. There were 21 and 20 turnovers, respectively, in the 4550BC-4450BC and 4500BC-4400BC windows. Except for the profusion of new trees since the 19^{th} century AD, no other part of the 8,000-year chronology approaches these values. The average is less than 10 turnovers/window. What is one to make of this? Not a single series free of inferred missing rings exists to "suture" this entire interval (a fact also true of several other intervals in the MWK chronology; see below). On the other hand, there are series that bridge this entire interval, and beyond, at (t)-values considerably higher than the highest false crossmatch value (t=7.8). It can therefore be concluded that there is no substantial "weak link" anywhere in the MWK chronology.

THE PROFUSION OF INFERRED MISSING RINGS (IMR)

Dendrochronology rests upon the premise that each tree ring represents one year, and that each ring is immediately successive to the previous one. In spite of this, however, the majority of the accepted MWK crossmatches can exist only through the inclusion of numerous zeroes as space fillers for IMR. Despite the fact that samples chosen for permanent inclusion in the MWK data set have, in general, been those with the fewest IMR, a survey of the entire chronology indicates that it cannot be constructed without the inclusion of series containing IMR. Moreover, in spite of this selectivity, some very "hole-filled" cores remain in the chronology. At one extreme, MWK801 (2672BC-797BC) contains 110 IMR, whereas, at the other extreme, only 8 series have no IMR. Out of some 100 cores spanning the 6000BC-1000BC interval, 36 have at least 2% IMR. To put this in perspective, the majority of extant BCP trees growing in the western USA have considerably less than 2% IMR [29].

Although much more common in MWK, IMRs also occur in large numbers in some CMP series. For instance, CMR451 (1347BC-128BC) has 14 IMR. Then again, CMP cores tend to be very much shorter than MWK cores. In terms of deployment of IMR within individual MWK series, a survey of long cores indicates that these occur at roughly equal frequencies in the 1st and 2nd 800 years of life. However, IMR often occur in clusters within individual series. For instance, a sliding window of 10 years contains 4 IMR in MWK613 near 4780BC. Other individual series, each containing 3-6 IMR, occur in 5-15 year windows near 5371BC, 5210BC, and 5185BC. There are even sequences within the MWK chronology that have 2-3 *consecutive* IMR.

The placement of IMR, from crossmatched series to series, is decidedly nonrandom: In particular, there are very many years in the entire chronology where the *majority* of rings are zero for a given year. This is true of 25 different years before 1000BC, and 45 total years for the entire MWK chronology. Furthermore, those years where two or more consecutive (or nearly consecutive) IMRs occur in at least one series tend towards an even greater tendency for consistency of IMRs in the vertical direction: 5371BC (32 of 33 cores, and 15 of 16 trees, are IMR that year); 5210BC (38/40 cores, 17/19 trees); 5185BC (20/21 trees), and 956BC (10/12 trees). In extant BCPs, the placement of IMRs can be sometimes be justified by the comparison of different BCP along a gradient of relative complacency to sensitivity [13]. By contrast, when zero rings are inserted in ancient BCP, they are usually placed at the same location as a corresponding narrow ring in the other series on the rationale that an absent (zero) ring in one series is likely to be manifested as a narrow ring in another. However, the size of BCP ring widths does not predict the numbers of IMR [36].

To what extent does the profusion of IMR raise doubts about the validity of the crossmatches on which the MWK chronology rests? Without a complex statistical text, this question cannot be definitively answered. However, a detailed analysis of the entire 1000 BC—6000 BC part of MWK appears to indicate that the removal of all IMR does not by itself invalidate the chronology. Although the MWK chronology cannot be constructed solely of IMR-free cores, large segments of it can, albeit with very small sample depth (usually only 1-3 series). Even with IMR removed, appreciably long segments of the altered series still crossmatch strongly with each other. Finally, when the 1st part of COF12K.EXE is run on the zero-removed series, the 50 year offset numerical experiments run by the program usually indicate a slightly-shifted strong crossmatching point against the local master chronology. This can be taken as strong independent justification for the existence of the IMR in the MWK chronology. However, the same test shows less compelling offset matches in the case of zero-removed CMP segments against the CMP master chronology, but then again IMR are relatively infrequent in CMP.

As an extreme test of the effects of IMR, a series of supposedly heterochronous MWK cores were made into several copies, with each copy having a zero inserted into a different multiple of 25 or 50 rings. When IMRs were thus experimentally added to incorrectly-crossmatched series at the 2% average rate commensurate for the MWK chronology, the rerun (t) value showed an improvement of up to 3 or 4 in both MWK and CMP. This closed the gap between the (t) values of the highest incorrect crossmatch in CMP and the median correct CMP crossmatch (t) value, and almost did the same in the case of MWK. It is unclear what the limit is for improvement of (t) values in the case of incorrect crossmatches, but the preliminary analysis does not indicate that a reasonable deployment of IMRs in false crossmatches could ever cause the emergence of (t) values that rival those of the higher inferred correct crossmatches.

As a further test, crossmatches suggested by COF12K.EXE, for different modified and unmodified series, were searched for newly caused internal replication, and a number of such instances were noticed. However, as is the case with the previously discussed 3-way reciprocal crossmatches whose reciprocity does not depend upon adding any IMR, the sample depth is not found to exceed three and the (t) values are unimpressively low. However, these latter instances can only understate the actual situation, as they employ only *one* added zero per series, and because relatively few possibilities had been examined owing to the extreme labor intensiveness of this procedure. In conclusion, the overall validity of the MWK and CMP crossmatches is provisionally accepted, but with some reservations related to the “play” in the data.

CONSEQUENCES OF MULTIPLE ANNUAL RINGS (MARs)

Assuming that members of the MWK and CMP had been coupled with the global atmospheric circulation for most of post-Flood history, the first 4000 or so rings of these chronologies must have grown in only about 1000 years in order to keep pace with ^{14}C chronologies (see Fig. 4 in [4]). To determine if two rings growing per year, insufficient by themselves to effect the fourfold time compression, would have been capable of generating new strong crossmatch points that would reduce the required amount of time another twofold, a numerical experiment was performed. Two ancient crossmatching BCP series were imported into Microsoft Excel[R]. From these, two new series were created per original series, one of whose ring measurements consisted of the sums of the odd (1^{st} +3^{rd}, 5^{th}+7^{th}, etc.) original rings, and the second consisted of their even counterparts (2^{nd}+4^{th}, 6^{th}+8^{th}). Upon re-conversion to the Measurements format, the six series were crossmatched by COF12K.EXE. No significant secondary crossmatching points were found. But this was only one test.

Apropos to the assumption of a straightforward fourfold time compression, the requisite 4 rings per year have erroneously been dismissed by some as impossible, but do in fact occur. Instances of 3-5 sharply defined annual-like rings per year have been described in various trees [17, 42], as have cases of 2-6 rings per year occurring on a regular basis in certain pines [6, 43]. As an alternative to regularly occurring MARs, one could envision episodic ones, that is, irregular bursts of non-synchronous growth occurring independently in trees of the BCP chronologies (for example, 2 or more rings in one year in one series while only one forms in another tree or trees, as necessary, to bring them in sync). The 50-year lag experimental part of the COF12K.EXE program, performed on inferred noncontemporaneous BCP, indicates that well-timed irregular bursts of growth would cause heterochronous BCP series to crossmatch. However, there would be so many potential crossmatches generated that they would be hard to sort out, and the original ostensibly correct crossmatches would not find obvious clarification. However, it is noteworthy that some of the high false crossmatches have numerous nonconsecutive narrow rings throughout the crossmatching intervals. This suggests that chaotic growth could lead to unambiguous high-(t) crossmatches were it limited to the larger rings, thus bringing the narrow rings closer together in each series. The original use of IMRs would then play a decisive role in having synchronized the intervals between the narrow rings of the original series. Further research in this type of chaotic growth is clearly warranted.

Young BCP trees can grow more than one ring per year [26], but it is unclear whether the same holds for older trees in the stripbark mode of growth, especially since this mode of growth is not well understood [34]. In his seminal study on BCP physiology, Fritz [13] mentions encountering but one instance of even an incipient double ring in BCP. But are extra rings in current BCP *actually* absent? Note that IMRs and MARs are mirror images of each other. A positional discrepancy of marchers in a parade can be caused *either* by one marcher taking an extra step *or* the other marcher omitting a step. Likewise, barring a counting error, a suddenly out-of-step series of paired tree-ring indices can be caused *either* by one series acquiring an extra ring *or* another series omitting a ring. It is more than possible that at least some IMRs are unrecognized MARs.

The fixed growth of BCP implies only one growth flush per year, and the short growing season (as little as 6-8 weeks: [13, 1]), combined with requirements for long winter bud dormancy followed by a long warm spell to break the dormancy, supposedly make it all but impossible for even two distinct growth flushes (and therefore even two distinct rings) to occur within the same summer. Would this have still been the case had the BCP growing season been longer in the past and/or strongly multimodal (i. e. perhaps several widely-spaced “growing seasons” within a same year)? For that matter, would BCP trees go into strip bark mode and live to appreciable ages under a longer growing season? Although a warmer distant past is a recognized part of BCP history [7], no substantive clues to these questions are offered in any of the numerous publications found in the BCP bibliography [31]. Likewise, discussions with specialists in BCP trees and general tree physiology make it obvious that matters related to the above questions have not been investigated to any significant degree.

Finally, our conclusions about MARs in BCP cannot rest solely on the behavior of presently living trees because plants change with time. The distinctness of tree-ring boundaries is largely under genetic control [11], and the same probably holds for MARs. Consider the fact that two species in the same genus (within the same Created Kind) can have widely divergent proclivities towards MARs [10]. As for BCP, there is a wealth of indicators that it is, or has recently been, quite plastic in terms of the genetics of its characteristics. This evidence includes regional gradients in the biochemistry of BCP [48], polymorphism in response to growth conditions [19], and the ability of BCP to hybridize freely with the morphologically different foxtail pine [19].

Taking this further, there is indication that trees recently introduced to seasonal climates tend to "microevolve" towards a progressively lesser tendency for MARs with time. There is a Central American species of pine [6] that shows both annual periodicity and 2-6 rings per year, and the retention of annual periodicity is believed to be the result of the tree's origin from higher latitudes. Reversing this reasoning, and assuming a preFlood world with much less pronounced seasonality than occurs at present, one can visualize the erstwhile warm-climate BCP trees having retained MARs in the cold high altitudes for some time after the Flood. If so, the occurrence of MARs in BCP was probably the norm in early post Flood times. Eventually the natural selection pressures found in the harsh, sharply-seasonal, high-altitude post Flood climate favored trees having only one ring per year, accounting for the fact that today's BCPs seldom if ever deviate from this mode. Until more is known about MARs in BCP, further development of MARs-related considerations cannot proceed. The model developed below can use, but does not require, any MARs at all.

NONCLIMATIC PERBURBATIONS OF TREE RINGS

It has been known for a long time that individual tree rings can be perturbed by non-climatic events, but these occurrences have generally been treated as sporadic events during the lifetime of a tree, or as continuous low-level modifiers of tree-ring widths throughout much of the lifetime of the tree. However, owing to the unsettled environment of the immediate post-Flood world, one must broaden this thinking to contemplate the occurrence of numerous large, frequently occurring perturbations of incipient tree rings. The crossmatches of the early part of the MWK and CMP chronologies may thereby indicate event-correlation of contemporaneous trees rather than time correlation induced by annual changes in climate.

Many different events are known to "overprint" incipient tree rings at different times in each tree. One notable form of time-transgressive activity is that of downslope ground movements, including slow-acting landslides. These can perturb tree rings recurrently on a time scale of at least several centuries [15,16], with individual suppression-release "overprints" on tree rings lasting anywhere from a few years to a few decades [3, 38]. Earth surface movements can be facilitated by earthquakes, which often cause a range of immediate to time-delayed surface activity [40]. Edaphic effects themselves can impose an age-staggered imprint on trees even when the causative event itself is not time transgressive. Consider, earthquakes, for instance. One tree, growing in loose material, may undergo perturbation of roots (and consequent small rings) as a result of an earthquake, whereas a nearby tree, rooted in solid substrate, is unaffected [24]. Owing to the fact that the postFlood regolith was undergoing large-scale lithification, with the nonlithified/lithified "front" changing with time, regional earthquakes must have left extensive "time-transgressive" marks on trees.

Ring width reductions caused by insect infestations often recur on a multi-century semi-cyclic basis [39]. There is a large and growing body of experimental evidence for excess CO_2 being a fertilizer for tree growth when mineral nutrients are not limiting [47]. If pulsed releases of subterranean CO_2 had migrated with time, both the time-transgressive crossmatches of the MWK and CMP series, as well as their progression of C14 dates (elaborated below) would find a unified explanation. Interestingly, large-scale disturbance-induced reductions in the neighborhood of 50% commonly occur in incipient tree rings [40], yet such reductions are well within the range expected from climatic effects. As for suppression-release patterns, these occur frequently in BCP (e. g., [5]).

EXPERIMENTS ON TIME TRANSGRESSIVE "OVERPRINTING" OF TREE RINGS

In order to do a test of the potential impact of non-cyclical but recurring high-frequency perturbations of tree rings, a series of numerical experiments were performed. Owing to space limitations, only a few of these are discussed. A certain fraction of tree rings were enlarged and/or reduced in order to see how relatively minor ring perturbation alters the correlation coefficients (r and t) on non synchronous parts of adjacently growing trees.

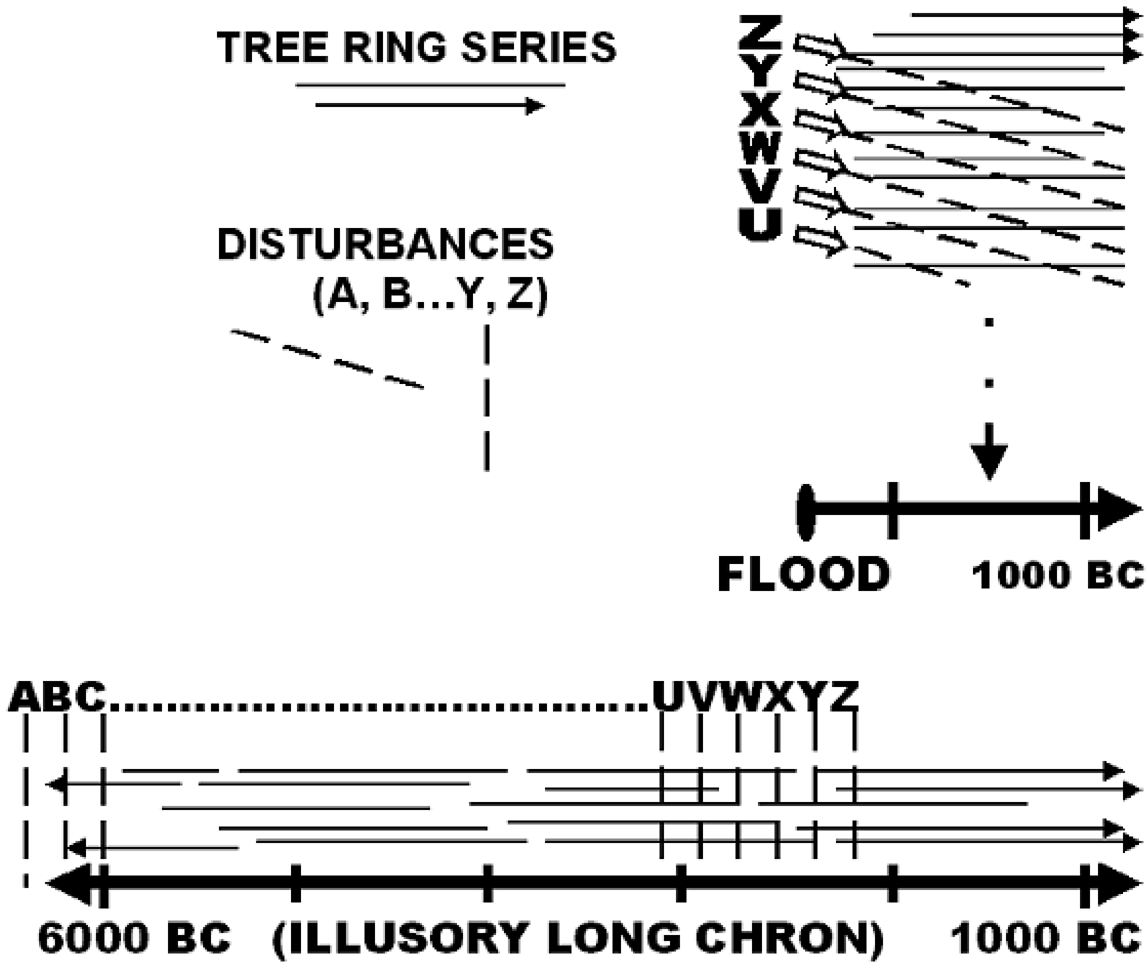

Figure 2. Generalized Mechanism for the Collapse of the BCP Long Chronologies.

A number of extant BCP were chosen that had begun growth during the AD period. To begin the experiment, the medieval first 290 years of one series was altered along with the most recent 290 years of another BCP series. All ring-width experimental alterations were performed with the ring widths listed as a decade of values expressed in hundredths of a millimeter (i. e., the Measurements Format of the University of Arizona Tree Ring Lab). Each decadal series was altered (**bold**) and left unaltered (no bold) as follows: 1st 2nd **3rd 4th** 5th **6th 7th** 8th 9th 10th. In terms of the magnitude of this experimental perturbation, the smaller ring width values were, in the first series, arbitrarily enlarged to 0.35mm, and larger ones to 0.45. The corresponding enlarged values for the second series were 0.45 and 0.55. Once crossmatched, the results were astounding. Not only did the altered contemporaneous series no longer crossmatch over most of their millennial length, but they now crossmatched strongly at a staggered interval. This, in turn, caused the two cores to cover twice their actual duration of existence. The correlation of the newly created 290-year segments was high (r=0.81, t=23.1). Note that this value is much higher than the earlier-quoted mean value for all correct MWK crossmatches.

Episodic changes in ring width size were also investigated. In each case, 2-3 consecutive rings were altered, amounting to 20-30% of the total, and these were interspersed between a few to several “random” successive ones were not. The two altered segments recurred at a nearly decadal interval (a mean recurrence at 9.84 rings with a STD of 3.89). Astonishingly, merely two moderately altered rings per decade were found to be sufficient to allow the affected segments to crossmatch at levels comparable to those at the lower end of MWK crossmatches. In yet another experiment, three consecutive rings were enlarged per decade, over a 370 year common interval to two series, using the following modest degree of enlargement: Original 0.01-0.10 mm rings enlarged to 0.25mm, 0.11-0.14 mm rings enlarged to 0.35, 0.15-0.19 ones to 0.40, and >=0.20 enlarged to 0.45. The two perturbed series crossmatched at the time-staggered 370-year interval (r=0.48, t=10.4). In still another experiment, an investigation was made of the effects of growth suppression on high frequency variance. Three consecutive rings, at the same spacing and common interval as in the previous experiments, were arbitrarily made only 0.05mm wide, with comparable results.

It can be concluded that high frequency variance is very sensitive to perturbation and that unusual values for tree ring width are not necessary to cause a marked change in crossmatching points at high statistical values. Earlier, it had been demonstrated that there is a great deal of variance within descriptive BCP tree ring statistics. A great deal of perturbation of BCP ring widths, in either or both the small or large directions, is therefore possible before the measurements would fall outside the wide range of values that is normal for BCP. Even though the foregoing experimental perturbations had been intentionally made severe in order to reduce the number of rings that had to be altered, more realistic, subtle perturbations acting upon a larger fraction of rings could be performed with comparable effects.

A MODEL FOR SHORTENING THE BCP CHRONOLOGIES

The low overall degree of cyclicity in the BCP data implies that ring-width perturbing events could not have been strongly periodic in recurrence. This means that crossmatch points must be unique and distinctively high, with all remaining alternatives comparatively weak.

To understand the model, the reader is first asked to visualize a large swimming pool containing a wave-making machine. Each wave spreads down the length of the pool, and different swimmers encounter each wave at different times, depending upon their location within the pool. The swimmers represent trees, the wave-making machine represents the unsettled postFlood crust, and the waves represent the disturbances that are radiating from its source(s).

The horizontal lines at the top right of Fig. 2 represent contemporaneous BCP trees growing in roughly the first millennium after the Flood. Throughout the multi-century lifetimes of the host trees (or active lobes of the same), some of the normally climate-controlled trees are being largely overprinted by the same disturbances at different times in their respective lives (letter-identified hashed lines forming acute angles with BCP trees). Crossmatching of the affected BCP trees inadvertently turns out to be according to the disturbances, staggering them into a false time-inflated chronology (Fig. 2, bottom). Considering the fact that parts of the affected postFlood trees are free of the exogenous imprinting, the unaltered parts crossmatch with those trees growing in the immediate postFlood world that had escaped perturbation (thus whose rings had remained climatically controlled). This effectively "roots" the inflated 1000BC-6000+BC chronology to the real (that is, climate controlled) 2000BC-Present chronology.

CO_2 EMISSIONS ACCOUNT FOR THE C14 TREE RING PROGRESSION

If the early part of the BCP chronology is not real, it is hardly surprising that C14 dates and tree ring dates drift 200 to 700 years apart in the BC period. To account for the existence of the C14/dendrodate progression itself, however, some creationist models call for the rapid accumulation of ^{14}C in the biosphere after the Flood. The chief difficulty with these and similar models is either (or both) a large range of C14 dates across relatively few tree rings, or a sharp discontinuity in C14 age occurring somewhere in the tree ring sequence [for further discussion, see Giem [14]). The model now presented overcomes this apparent problem. Its effects either replace, or are superimposed upon, earlier models of gradual accumulation of global ^{14}C.

As elaborated elsewhere [45], tree rings can acquire fictitiously high C14 dates by imbibing “infinitely old” CO_2 gas that is emanating from an underground source. Consider (shown as the "structure" in Fig. 3) the existence of a rapidly-arising, long-lasting, steady-state, suddenly-ending emission of this gas, and occurring throughout much of the region spanning the 16 km MWK-CMP distance, and nearly all of the few hectares on which all the MWK trees grew [22].

Immediately after the Flood, a large steady-state "infinitely old" CO_2 emission suddenly arose (the suddenness shown by the hidden “left wall” in Fig. 3). By the time the first grove of post Flood BCP began to grow (left dots, Fig. 3), those without the CO_2 emission region, having missed the sudden arising of the gaseous emission, acquired built-in apparent C14 ages that lacked major discontinuities. The CO_2 emission remained at essentially steady-state levels (the left-right horizontality of the "roof" in Fig. 3) throughout the life of these trees, thus maintaining a largely discontinuity-free correspondence between relative C14 age and relative tree ring age. There was, however, an overall gradient of emitted CO_2 concentration (the slope in the "roof" in Fig. 2), causing the trees growing within the affected zone to acquire progressively greater apparent C14 dates. Finally, there was a sudden end to the CO_2 emission (shown as the "right wall" in Fig. 2) and any of the CO_2-affected trees (or lobes) still alive at this time were killed. Note the end (right dots, Fig. 3) of all the CO_2-affected trees before or at the "right wall" in Fig. 3. A large shift of the regional upper crust is one mechanism that could have suddenly and simultaneously caused both events.

The reason for the "seamless" progression of C14 dates in the BCP calibration curves is simple: No tree was alive to record the precipitous change in C14 dates caused by either the sudden rise or the sudden collapse of the massive CO_2 emission. The emission itself produced a gentle gradient from zero to several thousand apparent C14 inherited years. This too facilitated the absence of sharp discontinuities in C-14 "age" between closely spaced rings. The net effect of the entire process is an apparent series of progressively older trees, both dendrochronologically (Fig. 2, bottom), and in terms of gentle increments in C14 age (Fig. 3). Some of the slightly "age-inflated" trees (shown at the foot of the sloping "roof" in Fig. 3) "root" the age-inflated and "overprinted" BCP to the remaining chronology by crossmatching with those BCP that had been unaffected by the "overprinting" during the same time period that had begun soon after the Flood.

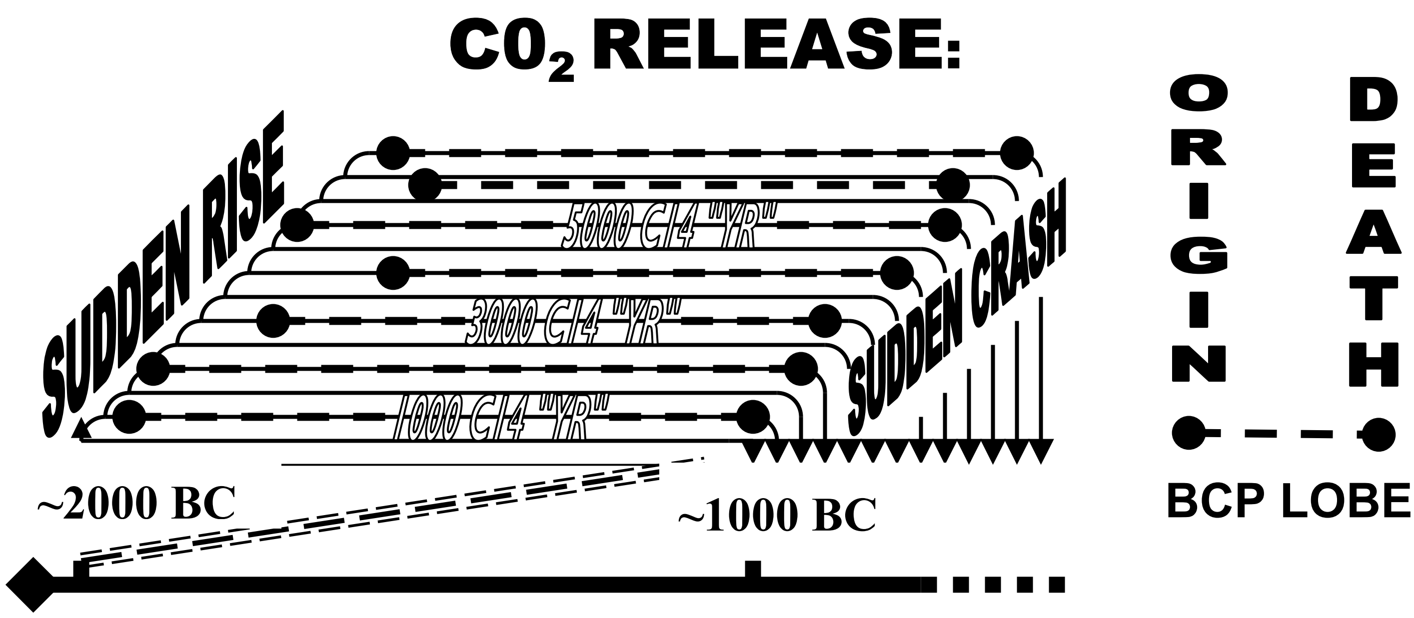

Figure 3. Processes Leading to a Discontinuity-Free C14 "Ageing" of Post-Flood BCP Trees.

ACCOMODATING NONIDEAL BEHAVIOR

The foregoing presentation (Figs. 2, 3) has necessarily been simplified for purposes of clarity. In actuality, there were hundreds of BCP trees involved, and there must have been multiple sources of disturbances and CO_2 emissions alike [46]. Note also that many BCP specimens do not crossmatch with any part of the sequence, despite having high mean sensitivity, and falling within the indicated time period (by C14). In the light of the model presented, these probably became dendrochronologically "illegible" by receiving an overlapping set of overprints. Series with all small rings likely experienced overprinting of sufficient intensity to suppress the tree's growth response.

The dates shown in Figs. 2 and 3 are idealizations, and should not be taken literally. For instance, the CO_2 emissions probably varied from a few centuries to perhaps a few thousand years. However, statements about a dead BCP containing 6,000 rings [2] find no support from any current BCP specialist. As for the date of the Flood, some individual living BCP trees (e. g. Methuselah, Curry Tree) apparently began growth before 2400 B. C., but it is unclear if the ring count comes from a single growth lobe or if it is interpreted from a composite of partially overlapping (or non overlapping) lobes.

It must be stressed that a precise repetition of "overprints" is not necessary for the model to be viable. As demonstrated earlier, tree ring crossmatches are very sensitive to even partial "overprints" of the affected series. At the same time, recall that a significant fraction of MWK and especially CMP crossmatches are not particularly strong, and there is "play" in the chronologies. This allows for a certain degree of flexibility in the relative placement of certain cores, thereby relaxing the constraints under which this alternative hypothesis of BCP crossmatchings must operate, even to a significant degree in many cases.

Owing to the magnitude of the CO_2 emission required by this model, the flux would be relatively insensitive to all but the most severe earthquakes. At the same time, constraints imposed by the perceived exactness of the hypothesized CO_2 emission are relaxed by the fact that the ^{14}C/BCP-chronology progression, while almost certainly real, has much more scatter than commonly supposed (see Fig. 5 of [41]). In addition, deviant C14 dates had been excluded from the calibration curve (e. g., [30]). Interlaboratory tests [23] on the reproducibility of both conventional and "high-precision" C14 dates, from a series of tree rings from the same tree, show surprisingly contradictory results, and more recent studies on the reproducibility of "high precision" C14 dates [35] suggest the same conclusion.

CONCLUSIONS

The crossmatching of the BCP tree ring series behind the alleged 8,000 years appears to be substantially sound, albeit with the invocation of numerous inferred absent rings and a potentially subjective relative dating of some of the cores. Our understanding of potential multiple annual rings in BCP is very limited. The multimillennial BCP chronologies can be shortened in half, with or without the presence of multiple annual rings, by allowing for a time-staggered nonclimatic perturbation of a large number of mutually-contemporaneous trees. A gradient of "infinitely-old" subterranean CO_2, areally superimposed upon these perturbed BCP trees, generates an apparent ^{14}C/dendrochronological progression. The BCP and ^{14}C model presented here is in accordance with the strictest Biblical chronology (the Flood at about 2400 BC), and is potentially adaptable to any long chronology on Earth.

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