CEN Tech. J., vol. 6(2), 1992, pp. 168–172

Were There Really No Seasons?: Tree Rings and Climate

DR KURT P. WISE

ABSTRACT

Tree rings contain a wealth of information on climate, biogeography, plate motion, and flood hydrodynamics. This data has been largely untapped by creationist researchers. Fossil trees capable of preserving rings are found in the fossil record from the Devonian to the present. Fossil rings indicate that the pre-Flood climate was probably strongly seasonal at high latitudes, which challenges the currently popular models of pre-Flood climate. Fossil rings also indicate that the immediate post-Flood world was warmer and wetter than the present, and that it cooled and dried off to the present. This evidence tends to confirm Oard's[1] Ice Age model.

The distribution of fossil trees implies that there may be some validity to inferred paleolatitude indicators. The distribution of fossil trees also suggests that translatitudinal transport may have been limited during the Flood — something which may put limitations on sedimentary transport models for the Flood.

INTRODUCTION

It is commonly believed[2,3] that the antediluvian world lacked seasonality, storms, latitudinal climatic gradients, and even wind, snow, and rain. This impression is indirectly derived from Scripture. The primary Scriptural indicators are:

(1) The *'waters which were above the firmament'* of Genesis 1:7 are interpreted as super-atmospheric water which created such a greenhouse effect as to homogenize global temperatures;

(2) The only mention of the pre-Flood water cycle is the *'mist'* (King James Version) of Genesis 2:6 which watered the ground just prior to the planting of the Garden of Eden; and

(3) The first Scriptural descriptions of wind (Genesis 8:1), snow (Job 6:16; Exodus 4:6), rain (Genesis 7:11), storms (Job 21:18), and climatic seasons (Genesis 8:22) occur during or after the Flood.[4]

That the earth had a unitemperate climate, however, may not be a **necessary** interpretation of these passages. For example, even if the Genesis 1:7 *'waters above'* refer to atmospheric or superatmospheric waters, they would not necessarily produce a unitemperate climate (just as a unitemperate climate does not result from the water in our present atmosphere). Furthermore, it is possible to interpret the *'mist'* of Genesis 2:6 as a singular rather than a normative event (for example, as God's special mode of preparing the garden of Eden for plants). Finally, the lack of specific mention of climatic change, precipitation, and wind is an argument from silence. If these things were commonplace, there would be no reason to expect them to be mentioned until they occurred with unusual magnitudes (for example, with the geocatastrophism of Noah's Flood). A uniform pre-Flood climate is not a **necessary** interpretation of Scripture.

To determine what the pre-Flood climate was truly like, it is necessary to supplement Scriptural data with physical data. This paper is an attempt to consider how fossil tree ring data may be able to aid us in interpreting antediluvian climate.

TREE-RINGS AND CLIMATE

The relationship between tree rings and climate in the present is actually quite complicated.[5,6] Some tree species lack rings regardless of climate, while the rings of other species are very sensitive to even the most minor variations in temperature and/or precipitation. In general, the following tends to be true of modern gymnosperms:[7–10]

(1) rings are lacking in a majority of trees in uniform subtropical to tropical climates;

(2) the more optimum the temperature and moisture, the wider the rings in climate-sensitive trees;
(3) the more rapidly the seasons change, the narrower and more distinct the latewood ring (cells formed in the last part of the growing season);
(4) variability in seasons from one year to another tends to produce variability in ring widths;
(5) trees subject to stressful growth (namely late frosts or severe droughts) tend to produce 'false rings' (additional rings identifiable by means of damaged cells, anomalous widths, etc.).

Although individual exceptions can be found to all dendrochronological relationships, a large sample of modern tree species from an area can reliably indicate several aspects of the climate in that area. One can determine whether the climate is strongly seasonal or not, whether the climate during a series of years is variable or consistent, whether growing conditions are optimal or poor, whether seasons change rapidly or gradually, and whether or not the trees experience stressful frosts and/or droughts. It should be possible, then, to examine tree rings from the fossil record to determine past climatic conditions.

PAST TREES AND CLIMATE

Fossils capable of preserving rings if they were in the original wood are known from every geological system from the Devonian through the Quaternary.[11–14] Taking the data of Creber and Chaloner,[15–18] supplemented with data from Parish and Spicer,[19] Francis,[20,21] and Dubiel *et al.*,[22] an effort is made here to determine what tree rings can tell us about pre-Flood climates.

Rings are lacking or very weak in all known Devonian woods. These gymnosperms *(sensu lato)* are quite different from any of those in the present, and our sample size of fossil trees and species diversity is rather low, but if the relationship between rings and climate is similar to that in modern gymnosperms, then known Devonian trees most likely lived in a non-seasonal environment. Paleomagnetism and other paleogeographic indicators seem to indicate that only one wood (at an inferred paleolatitude of 39°) was deposited at a locality greater than 30° latitude from the equator — the approximate latitudinal limitation of modern non-seasonal environments. Since it still remains to determine how accurate such latitude indicators are in a creation model, and it is not possible to determine how far the wood was transported before burial, it is unclear what is indicated about the earth's climate by Devonian trees. The trees would be as consistent with a worldwide, non-seasonal environment as they would be with a seasonality similar to the present with substantial trans-latitudinal post-mortem transport, as they would be with moderated seasonality over the present (that is, more poleward location of current climatic bands).

Similar to Devonian woods, most Carboniferous woods lack rings. Carboniferous taxa are slightly more familiar to us than Devonian taxa and the sample size of Carboniferous specimens and species is larger than in the Devonian. As a result, our confidence that most Carboniferous woods are from non-seasonal climates is greater than in the case of Devonian woods. The inferred paleolatitudes of most of the woods are within 20° of the equator, which is well within the latitudinal range of modern non-seasonal climates. The only Carboniferous fossil wood known to the author outside this band is one from 49°N paleolatitude. It is also the only known Carboniferous wood to have prominent growth rings. It is possible that this wood is incorrectly dated or that it is a wood from a non-seasonal climate which produces clear rings (for example, because of budding or flowering periodicity). However, a slightly simpler hypothesis is that the wood was buried during the deposition of Carboniferous rocks and is from a strongly seasonal climate consistent with its inferred paleolatitude. Although more Carboniferous wood from high paleolatitudes is needed to more confidently make the claim, evidence indicates that at least some Carboniferous trees grew in a strongly seasonal climate.

The Permian System contains a number of trees from both high and low paleolatitudes. Woods from within 30° of the paleoequator (European, Asian, and Canadian localities) have either weak or non-existent rings. Woods from more than 40° away from the paleoequator (the Gondwana localities of Africa, Antarctica, South America, and India) have prominent and wide growth rings, even up to 70° from the equator. Although Gondwana flora is largely unfamiliar to us and may not have needed climatic seasonality to produce prominent rings, a better actualistic interpretation is that many Permian trees grew in areas of strong climatic seasonality. Furthermore, although the modern latitude of fossil wood sites does not correspond well with ring-inferred seasonality, the **paleo**latitudes correspond quite well. This seems to argue for at least the partial reliability of paleolatitude determination and against substantial trans-latitudinal transport of fossil wood during the deposition of Permian rocks.

The only Triassic wood claim is from Arizona's petrified forests. With an inferred paleolatitude of 5°–15°N, one tree lacks growth rings while others show very wide, prominent growth rings. Investigations of these woods are still underway, but they would seem to indicate that some Triassic trees grew in areas of strong seasonality. The variety of growth ring types may indicate
(1) taxa with a wide variety of growth ring responses lived in a single seasonal climate and very little relative transport has occurred; and/or
(2) taxa from a variety of climates have been deposited together due to substantial transport, and/or
(3) climatic conditions were very different over rather small lateral distances.

More Triassic wood from this locality and others is needed to resolve this question.

As in Permian rocks, Jurassic, Cretaceous, and Early Tertiary rocks have paleolatitude indications ranging from tropical to polar regions. Rings also range from non-existent to prominent. Weak or non-existent rings are nearly always restricted to rocks formed within 33°–34° of the paleoequators (with the exception of a Lower Cretaceous wood at paleolatitude 36°N and an Upper Cretaceous wood at paleolatitude 48°S). Once again, the consistency of paleolatitude indications and ring-inferred climatic seasonality argues for at least the partial reliability of paleolatitude indicators and against substantial trans-latitudinal transport of the trees buried in Cretaceous through Early Tertiary rocks. Although latitude-bounded, non-seasonal and seasonal climatic zones are indicated by Mesozoic, Cenozoic, and modern fossil woods, the locations of the latitudinal boundaries may well be different. Modern non-seasonal environments are completely restricted to within 30° of the equator. Mesozoic fossil woods, on the other hand, indicate non-seasonality at 31°, 32°, and even 36° and 48° away from the equator. Additionally, the widths of annual rings in modern trees is restricted to substantially less than 1 mm in width at latitudes greater than 70° latitude away from the equator. In Mesozoic and Cenozoic rocks, however, woods at paleolatitudes in excess of 80° North and South have annual rings substantially greater than 1 mm width. This evidence can be explained by

(1) a systematic error in paleomagnetic determinations, and/or
(2) limited trans-latitudinal post-mortem transport, and/or
(3) broadened climatic belts brought about by a more mild climate.

DISCUSSION

The rings of trees buried in Flood and/or pre-Flood sediments should indicate something of the pre-Flood climate. Creationists differ on where the pre-Flood/Flood and Flood/post-Flood geological boundaries should be defined. Many feel that the entire Precambrian is pre-Flood,[23] while others feel that some or much of the Precambrian was deposited in the Flood.[24,25] At this point, regardless of where the pre-Flood/Flood boundary is drawn stratigraphically, all fossil wood seems to have been deposited **after** the beginning of the Flood. The Flood/post-Flood boundary, on the other hand, is much more critical to this discussion. Although many creationists would seem to include all Phanerozoic deposits less the Holocene among Flood deposits,[26] others would tend to include all the Phanerozoic less the Neogene.[27,28] Others would tend to include only the Paleozoic and Mesozoic,[29] others would include only the Paleozoic or Lower Paleozoic,[30] while others would remind us that the boundary may have to be determined differently in different places.[31] Much research is needed to determine which of these boundaries provides the best explanation for the geological column. This paper provides data which needs to be evaluated in that research, but insufficient data to decide from among the various theories.

With the tree ring data reviewed here, no clear change occurs in the nature of ring patterns throughout the Devonian to the present. Thus no clear Flood/post-Flood boundary suggests itself. It might be argued that a boundary exists at the beginning of the Permian when numerous seasonality-indicating rings first occur. However, since all pre-Permian trees which indicate non-seasonality are also inferred **for other reasons** to have been deposited in low paleolatitudes, it is not clear whether or not any true climatic change occurred at this boundary. The lack of seasonality in pre-Permian trees might be used to argue for Joachim Scheven's[32] model of early Paleozoic rocks burying elements of a non-seasonal pre-Flood world, followed by post-Carboniferous rocks burying elements of a seasonal post-Flood world. However, the same data might be used to argue that the Flood at first buried primarily the tropical to subtropical biota and only later (in post-Carboniferous rocks) burying the temperate and polar biota. Or, it can be used to argue that evidence of seasonality exists in early Flood rocks, but that the rocks from high paleolatitudes (northern Russia, Antarctica, and the southern parts of South America, Africa, and India) have not been well searched for fossil wood.

It is this author's opinion that each of these theories may in some part be true.

(1) There is evidence in wide growth rings (that is, rapid growth rate) at high latitudes that climatic zones may have had more poleward boundaries. Thus although pre-Flood non-seasonality may not be indicated in fossil woods, a more moderate pre-Flood climate than at present **may** be indicated;
(2) If Flood sediments were deposited by means of water driven by tidal resonance,[33] equatorial deposition may have been more substantial early in the Flood until water accumulated enough to inundate higher latitudes. If deposition did tend to proceed from the equator toward the poles, the unfamiliarity of much of the Lower Phanerozoic biota might be partially explainable. Until the earth fully recovered from its diluvial catastrophe, post-Flood world climate was probably rather variable and unpleasant. This may have led to the demise of much of the pre-Flood equatorial biota, and would explain why fossils tend to look more 'modern' as one goes up the stratigraphic column;
(3) Southern Gondwana and northern Russia localities are not well sampled for fossils. Modern climate in these regions is unfavorable, population density is low, and paleontology is not a strong component of academia in many of these countries.

To decide among these various ideas, more literature and field claims of fossil wood and other taxa are needed.

The stronger correlation of ring-inferred climates with paleolatitudes as opposed to present latitudes seems to imply that paleolatitude determinations may provide useful information about where a rock was actually formed. The validity of each paleolatitude indicator needs to be re-evaluated within a creationist model. Since rapid plate motion[34] and rapid magnetic field reversals[35] may be possible during the Flood, there is no general theoretical reason why paleomagnetic latitude determinations should be invalid in a creationist context. In fact, if creation-model-consistent paleolatitude indicators (including, for example, paleomagnetism) were established, a very powerful tool would be available to creationists. Information from such a tool would help us fix stratigraphic boundaries for the Flood, determine dynamics of lithospheric plates, deposition, and deformation, and infer pre-Flood biogeography, climate, and geography.

The similarity in latitudinal bands of seasonality in the present with those inferred from the fossil wood implies that relatively little trans-latitudinal transport occurred during and after the Flood. If such a claim is substantiated in other ways (for example, for other taxa), it would put some important constraints on Flood models. Chadwick's[36] ongoing research on inferred current directions in the geologic record seems to indicate that there is a tendency for Flood currents to parallel latitudinal lines. This is certainly consistent with the limited trans-latitudinal transport inferred from fossil trees. If this data is substantiated, Flood models must explain a dominant latitude-parallel current direction. As an example, Clark and Voss's[37] tidal resonance model provides a moon-driven mechanism for powerful East-to-West currents during a global Flood.

CONCLUSION

The partial sample of fossil woods used in this paper supplemented with a complete survey of woods reported in the literature, should contribute substantially towards understanding both the pre-Flood world and Flood dynamics. If the Flood/post-Flood boundary is placed near the Permian boundary or below, the evidence for pre-Flood seasonality from tree rings is inconclusive. If the Flood/post-Flood boundary is placed any higher in the stratigraphic column, the tree ring evidence for strong pre-Flood seasonality is substantial. In Jurassic woods,[38,39] for example, there is evidence of strong seasonality (prominent growth rings with a clear earlywood/latewood distinction), rapid seasonal change (narrow latewood), late frosts (damaged cells and false rings in earlywood), and severe droughts (false rings in mid- to late- season growth). If as this author believes (research in progress), the Flood/post-Flood boundary is closer to the Mesozoic/Cenozoic boundary, then seasonality, rapid seasonal changes, late frosts, and severe droughts characterized the high latitude regions of the pre-Flood world. This evidence is consistent with the recent re-evaluations[40] of many of the claims of the unitemperate canopy model of Joseph Dillow and others.[41,42] It is no longer clear that any viable pre-Flood canopy can produce a non-seasonal world. A re-evaluation of all canopy theory claims and evidences is needed.

Fossil tree rings can also aid in our understanding the complex, rapidly changing climate of the post-Flood world. If the Flood/post-Flood boundary is placed at or below the Cretaceous/Tertiary boundary, there is substantial evidence in fossil rings that the post-Flood climate was not only strongly seasonal, but was also in some sense milder than the present. The narrowing of ring-inferred climatic zones from the Flood to the present indicates that mean global temperature has probably dropped from the Flood to the present. Furthermore, since water is usually the limiting factor in modern growth rates of trees,[43,44] the large and constant width of many high paleolatitude tree rings implies that substantial and constant rainfall characterized many parts of the earth, including the highest latitudes (for example, Antarctica). Each of these observations is consistent with the claims of Michael Oard[45] that the immediate post-Flood ocean was warmer than at present, and was cooled by means of its evaporation and subsequent precipitation over the land. The cooling of the oceans would produce the mean cooling of the earth shown in the narrowing of climatic zones. The warm ocean driven precipitation would not only explain the accumulation of ice in the polar regions which led to the Ice Age, but would also explain the substantial and constant rainfall indicated by wide growth rings at all latitudes. Perhaps the often severe climatic gradients produced in Oard's model can explain the great climatic range of trees in certain post-Flood deposits (for example, in the Ginkgo Petrified Forest of Oregon).[46] Further light can be shed on such deposits from tree ring studies. In short, further studies of post-Flood growth rings can aid in our understanding of post-Flood climatic and biogeography models.

Fossil tree rings can be a fruitful source of data on the climatic and geological dynamics of the past. They may be used to infer pre-Flood and post-Flood climate, and then that information can be used to choose among or develop pre- and post-Flood climatic models. The place of growth versus place of burial of fossil woods can indicate the nature of depositional processes as well as the motion of lithospheric plates. This information, in turn, can be used to choose among and develop models of Flood dynamics.

ACKNOWLEDGMENTS

I wish to thank Dr Andrew Snelling for showing me a Permian fossil wood locality which stimulated me to engage in this project, and then for his discussion and

encouragement which ultimately compelled me to write this paper, and finally for his critique of an earlier draft of this paper.

REFERENCES

1. Oard, M. J., 1990. An Ice Age Caused by the Genesis Flood, Institute for Creation Research, Santee, California.
2. Whitcomb, J. C., Jr and Morris, H. M., 1961. The Genesis Flood, Presbyterian & Reformed, Philadelphia, Pennsylvania, 518 pp.
3. Dillow, J. C., 1981. The Waters Above: Earth's Pre-Flood Vapor Canopy, Moody Press, Chicago, Illinois, 479 pp.
4. See Dillow, Ref. 3 for more justifications for the pre-Flood canopy theory.
5. Fritts, H. C., 1966. Tree Rings and Climate, Academic Press, New York, 567 pp.
6. Creber, G. T., 1977. Tree rings: A natural data-storage system. Biological Reviews, 52:349–383.
7. Chaloner, W. G. and Creber, G. T., 1973. Growth rings in fossil woods as evidence of past climates. *In:* Implications of Continental Drift to the Earth Sciences, Volume 1, D. H. Tarling and S. K. Runcorn (Eds), Academic Press, New York, New York, pp. 425–437.
8. Creber, G. T. and Chaloner, W. G., 1984. Climatic indications from growth rings in fossil woods. *In:* Fossils and Climate, P. Brenchley (Ed.), Wiley, New York, New York, pp. 49–74.
9. Creber, G. T. and Chaloner, W. G., 1985. Tree growth in the Mesozoic and Early Tertiary and the reconstruction of paleoclimates. Palaeogeography, Palaeoclimatology, and Palaeoecology, 52:35–60.
10. Creber, G. T. and Chaloner, W.G., 1987. The contribution of growth ring studies to the reconstruction of past climates. *In:* Applications of Tree-Ring Studies: Current Research in Dendrochronology and Related Subjects [Bar International Series No. 333], R. G. W. Ward (Ed.), BAR, Oxford, England, pp. 37–67.
11. Chaloner and Creber, Ref. 7.
12. Creber and Chaloner, Ref. 8.
13. Creber and Chaloner, Ref. 9.
14. Creber and Chaloner, Ref. 10.
15. Chaloner and Creber, Ref. 7.
16. Creber and Chaloner, Ref. 8.
17. Creber and Chaloner, Ref. 9.
18. Creber and Chaloner, Ref. 10.
19. Parrish, J. J. and Spicer, R. A., 1988. Middle Cretaceous wood from the Nanushuk Gr., Central North Slope, Alaska. Palaeontology, 31(1):19–34.
20. Francis, J. E., 1984. The seasonal environment of the Purbeck (Upper Jurassic) fossil forests. Palaeogeography, Palaeoclimatology, and Palaeoecology, 48:285–307.
21. Francis, J. E., 1987. The palaeoclimatic significance of growth rings in Late Jurassic/Early Cretaceous fossil wood from southern England. *In:* Applications of Tree-Ring Studies: Current Research in Dendrochronology and Related Subjects [BAR International Series No. 333], R. G. W. Ward (Ed.), BAR, Oxford, England, pp. 21–36.
22. Dubiel, R. F., Parrish, J. T., Parrish, J. M. and Good, S. C., 1991. The Pangaean megamonsoon — evidence from the Upper Triassic Chinle Formation, Colorado Plateau. Palaios, 6(4):347–370.
23. Whitcomb and Morris, Ref. 2.
24. Snelling, A. A., 1991. Creationist geology: Where do the 'Precambrian' strata fit? CEN Tech. J., 5(2):154–175.
25. Hunter, M. J., 1992. Archaean rock strata: Flood deposits — The first 40 days. *In:* Proceedings of the 1992 Twin-Cities Creation Conference, Twin-Cities Association, Genesis Institute, and Northwestern College, St Paul, Minnesota, pp. 153–161.
26. See, for example, Whitcomb and Morris, Ref. 2.
27. Woodmorappe, J., personal discussion.
28. Roth, A., personal discussion.
29. Wise, K. P. and Austin, S. A., research in progress.
30. Scheven, J., 1990. The Flood/post-Flood boundary in the fossil record. *In:* Proceedings of the Second International Conference on Creationism, Volume 2, R. E. Walsh and C. L. Brooks (Eds), Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 247–266.
31. Snelling, Ref. 24.
32. Scheven, Ref. 30.
33. Clark, M. E. and Voss, H. D., 1990. Resonance and sedimentary layering in the context of a global Flood. *In:* Proceedings of the Second International Conference on Creationism, Volume 2, R. E. Walsh and C. L. Brooks (Eds), Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 53–60.
34. Baumgardner, J. R., 1990. 3-D finite element simulation of the global tectonic changes accompanying Noah's Flood. *In:* Proceedings of the Second International Conference on Creationism, Volume 2, R. E. Walsh and C. L. Brooks (Eds), Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 35–50.
35. Humphreys, D. R., 1990. Physical mechanism for reversals of the earth's magnetic field during the Flood. *In:* Proceedings of the Second International Conference on Creationism, Volume 2, R. E. Walsh and C. L. Brooks (Eds), Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 129–140.
36. Personal communication.
37. Clark and Voss, Ref. 33.
38. Francis, Ref. 20.
39. Francis, Ref. 21.
40. Rush, D. E. and Vardiman, L., 1990. Pre-Flood vapor canopy radiative temperature profiles. *In:* Proceedings of the Second International Conference on Creationism, Volume 2, R. E. Walsh and C. L. Brooks (Eds), Creation Science Fellowship, Pittsburgh, Pennsylvania, pp. 231–242.
41. Dillow, Ref. 3.
42. Whitcomb and Morris, Ref. 2.
43. Fritts, Ref. 5.
44. Creber, Ref. 6.
45. Oard, Ref. 1.
46. Coffin, H. G., 1974. The Ginkgo Petrified Forest. Origins, 1(2):101–103.

Dr Kurt P. Wise has a B.A. from the University of Chicago, and an M.A. and a Ph.D. in palaeontology from Harvard University, Massachusetts, USA. He now serves as Assistant Professor in Science and Director for Origins Research at Bryan College, Dayton, Tennessee. He is actively involved in various creationist organisations in North America.