

Long-Lived Trees: Their Possible Testimony to a Global Flood and Recent Creation

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ABSTRACT

The Old and New Testament Scriptures, combined with secular historical records, allow the Bible historian to establish a chronology of earth and human history from the time of the creation through to the present day. The genealogy contained in Genesis chapter 5 provides a basis for dividing human and earth history into two distinct periods — an antediluvian (or pre-Flood) epoch of approximately 1,656 years and a postdiluvian (or post-Flood) epoch in excess of 4,300 years. The Old Testament Scriptures also allude to the existence of trees of great longevity (Isaiah 65:20,22). In the following paper a review is conducted of various tree-ring studies around the world, including the extended bristlecone pine (Pinus longaeva, Pinus aristata) and combined English and durmast oak (Quercus robur, Quercus petraea) chronologies. It is suggested that such studies provide a measure of prima facie and circumstantial evidence for a global Flood less than 5,000 years ago and a creation date less than two millennia earlier. Evidence is also cited in support of a single, post-Flood Ice Age.

INTRODUCTION

The Science of Dendrochronology

The science of **dendrochronology**¹ is founded on two established premises. Firstly, that the approximate age of certain species of trees can be ascertained through the counting of their **annular** (or **annual growth**) **rings**. Secondly, that variations in the width of these annular rings provide a measure of insight into both short and long-term climatic fluctuations during the tree's life. These variations enable the dendrochronologist to identify distinctive patterns — called '**ring signatures**' — in both living and fossilised stands of trees. Such signatures are often unique to localised areas of the earth's surface and their prevailing climatic regime. The correlation of signatures in and between living, recently living and

fossilised (petrified) trees enables extended tree-ring chronologies to be constructed.

Now it is at the base of a tree trunk that we find the maximum number of tree-rings — the centre of the tree's core (or **pith**) at this level approximating its germination point. In species where growth is exceedingly slow (for example, bristlecone pines) it is critical to obtain core samples from this region. On the other hand, where growth is rapid (for example, in sequoias and karris) it usually suffices to obtain samples at breast height; that is to say, about 1.3 metres (4 feet 3 inches) above the forest floor.

In temperate and, to a lesser extent, sub-tropical regions of the earth it is common to find many species of trees which regularly add a new layer of **xylem cells** beneath the **cambium layer** each year. This new growth,

when viewed cross-sectionally through the trunk, assumes the form of a single, new ring around the circumference of the tree. Growth takes place mainly during the spring growth season and the ensuing summer period of each year. Each ring comprises two distinctive colour bands. During early spring new wood of low density and lightly coloured cellular structure (**early wood**) is added to the tree. The cellular structure becomes denser and darker in colour (**latewood**) prior to the tree's dormancy phase during the following winter.²

The size, nature and frequency of ring formation will differ in accordance with site, climatic and age factors. For instance, ring width will gradually decrease as a tree approaches maturity and senescence. Annular ring formation may also vary greatly between differing genera and species of tree.

Ring patterns may be described as being either **complacent** or **sensitive** with respect to climatic variation.³ When very little variation in ring width is observed in a particular specimen from year to year it is said to be 'complacent'. This usually indicates that the tree has been well-watered over an extended period of time (that is to say, it has occupied a favourable and often level site with a consistently high water table). On the other hand, where factors favourable to growth are limited (for example, in the case of a sloping terrain with rock substrata) there is likely to be **greater sensitivity to climatic variations**. In such cases the trees are said to be 'sensitive' and, therefore, suitable for cross dating, chronology construction and the study of past climatic variations (**dendroclimatology**). They may also be employed in establishing past patterns of streamflow (**dendrohydrology**). However, one of their main applications to date has been in the area of archaeology — principally the dating of prehistoric Indian ruins in the southwestern United States.

Dense clusterings of trees (as opposed to open sites with few trees) will often lead to intensive competition for essential nutrients, sunlight and moisture. Narrow growth rings are more likely to develop under such circumstances.⁴

Prolonged periods of drought may also 'stunt' growth to such an extent that the annular ring is either **partially formed** or completely **missing**.⁵ Ferguson⁶ has noted that the probability of missing rings is **profoundly greater in sensitive specimens**. Conversely, prolonged periods of moisture may nullify or suppress the development of the distinctive latewood.⁷ Furthermore, if several distinct and alternating periods of wet and dry occur within a single year, **extra** (or **false interannular**)⁸ **rings** may develop.⁹

Ferguson¹⁰ has also stated that:

'A tree-ring sequence exhibiting extreme sensitivity, having almost the appearance of erratic growth, may contain less than 90 percent of the annual rings along a single radius and thus be **too difficult to use initially in chronology building**. . . .'

In most species, however, the incidence of extra rings is **generally greater than that of missing rings**.

Sorensen,¹¹ for instance, has noted that in selected species up to 30 percent of the total count have been deemed to be extra rings, whilst the incidence of missing rings has seldom exceeded 10 percent. Therefore, calculated ages of long-lived trees are **more likely to err on the high side of actuality**. Furthermore, certain genera and species of trees are virtually useless to the dendrochronologist because they frequently produce more than one ring during a year; for example, the cypress, *Cupressus arizonica*, and several species of the genus *Juniperus*.¹²

Whilst much controversy surrounds the extended bristlecone pine tree-ring chronologies,^{13,14} the determined ages and changes in the very nature of the annual rings of the earth's oldest living (and/or recently living) trees can tell us much about past earth history. The following study will focus upon various long-lived species from both of the earth's hemispheres, including: the coastal redwoods (*Sequoia sempervirens*), giant sequoias (*Sequoiadendron giganteum*) and bristlecone pines of the western and southwestern United States of America; the English yew (*Taxus baccata*) and the common and durmast oaks from the British Isles and western Europe; the negrohead beech (*Nothofagus moorei*), brush box (*Lophostemon confertus*) and Huon pine (*Lagarostrobos franklinii*) trees of eastern Australia; the native kauri tree from the North Island of New Zealand (*Agathis australis*), and the alerce (*Fitzroya cupressoides*) and southern beeches (*Nothofagus betuloides*) of South America. Several other long-lived species, including the western juniper from California (*Juniperus occidentale*), the native King Billy and Pencil pines of eastern Australia (*Athrotaxis selaginoides* and *Athrotaxis cupressoides*, respectively) and the South African mountain cedar (*Widdringtonia cedarbergensis*) will be mentioned, amongst others, in passing.

Factors Influencing the Potential Longevity of Trees

There are a number of factors which, singularly or collectively, determine the longevity of a tree. Aside from inadequate supply of nutrients and water and competition for same, other factors which, potentially, limit the longevity of a tree include:

- (1) The inability of most trees to maintain a given proportion of crown (the branches and leaves) to bole (trunk) as they continue to grow.
- (2) The vascular system's inability to draw up sufficient nutrients and water to the top of the organism.
- (3) The fact that the sheath of new (sap)wood added during each growing season becomes progressively thinner with increased age.
- (4) The older rings become non-functional and increasingly brittle with increasing age; the latter being especially prevalent in Sierra redwoods.

- (5) The increased susceptibility of a tree's core (or heartwood) to fungal attack with increasing age — such attack usually taking place from the pith outwards and requiring aerated conditions within the tree trunk.
- (6) The diminishing ability of some trees (for example, eucalypts) to replace their crowns with minor extensions of their branches.
- (7) The susceptibility of some trees to insect predation and fungal blights and their inability to effectively counter such attacks with secreted resins (for example, amber), tannins and anti-fungal substances (for example, pinosylvin).
- (8) The tree's inability to survive and regenerate after forest fires. The survival of long-lived conifers such as the coastal and giant redwoods is largely attributable to the thickness of their bark (for example, the bark of mature coastal redwoods may be as much as 300mm thick, whilst that of Sierra redwoods may be as great as 600mm, or 2 feet).
- (9) The flammability of tree resins.
and
- (10) The tree's inability to withstand gale force winds (which is related, in part, to the degree of buttressing at the base of the trunk, the state of the heartwood at the trunk base, the depth of the tap root and the breadth and condition of the root system, generally).

THE LONGEVITY OF EXTANT TREES — A GLOBAL PERSPECTIVE

Long-Lived Trees from North America

The North American continent is home to many species of long-lived trees including the western juniper, the coastal and giant redwood and, of course, the bristlecone pine.

The Western Juniper

The **western juniper** (*Juniperus occidentale*) is native to the western United States — in particular, California. Concerning this species of conifer **Edmund Schulman** (1908–1958) has stated:

*'It is curious, and perhaps significant, that the oldest bristlecone pines and the oldest giant sequoias are neighbours separated only by a few score airline miles. About the same distance away, in Yosemite National Park, stand millenniums-old trees of still another species, the western juniper.'*¹⁵

Ages of 2,000 years had been established for various gnarled giants above Yosemite's Tenaya Lake prior to the present century. More recently, however, studies of living stands of western juniper near Sonora Pass (immediately to the north of Yosemite National Park) have suggested **a maximum age of at least 2,500!**¹⁶

But what of the ages ascribed to the coastal and Sierra (giant) redwoods, and the bristlecone pines?

The Coastal and Sierra (Giant) Redwoods

Prior to the early 1950s it was generally believed that the oldest living things on earth were the giant sequoia trees of California — the **coast redwood** (*Sequoia sempervirens*) and the **Sierra** or **giant redwood** (*Sequoiadendron giganteum*; formerly *Sequoia gigantea*). The latter are aptly described as '**Big Trees**', being the largest (most massive) trees on earth.

Stands of coast redwood are scattered along the coastal regions of California and southern Oregon — between latitudes 35°N and 42.5°N. Perhaps the best known groves are to be found in the **Muir Woods National Monument**, north of San Francisco, and the **Redwood National Park**. The heights of mature coast redwoods vary from 30 to 117 metres (100 to 385 feet), whilst their trunks range up to 7.5 metres (25 feet) in diameter.¹⁷

By way of comparison, the giant redwood is largely confined to the western slopes of California's Sierra Nevada — between latitudes 36.5°N and 38.5°N. Most are found in a few scattered groves in **Sequoia, Kings Canyon and Yosemite National Parks** and at elevations ranging from 1,500 to 2,400 metres (5,000 to 8,000 feet). Mature Sierra redwoods range from 46 to 99 metres (150 to 325 feet) in height.¹⁸

Sequoias maintain a tall and spired-form during the rapid initial growth phase. Maximum crown height is reached within a few centuries of germination. The crown, by this time, is becoming increasingly rounded (dome-shaped), and the trunk continues to 'fatten' for the remainder of the tree's life. (This process of development is common in many other genera of long-lived trees, including the Australian karri, *Eucalyptus diversicolor*, and the kauri pines of south-east Asia and Australasia).

Exhaustive dendrochronological studies (**tree-ring counts**) have indicated lifespans for most coast redwoods of between 700 and 1,200 years. An age of approximately 2,200 years has been assigned to the oldest specimen of coast redwood.¹⁹ However, there is an abnormally high incidence of missing rings in coast redwoods due to differential growth and spiralling compression wood.²⁰ Therefore, the assigned maximum age for coastal redwoods may well be conservative.

By way of comparison, many living Sierra redwoods fall within the 1,500 to 3,000 year age range.²¹ A few even exceed 3,000 years.

One of the oldest documented specimens of giant redwood, the **General Noble tree**, from Sequoia National Park, was said to have been more than 3,200 years old when it was felled in 1892.^{22,23} The investigations of **Ellsworth Huntington** (1876–1947) and others during the early years of this century revealed no less than four felled stumps containing more than 3,000 growth rings. However, the famous American naturalist (and early creationist), **John Muir** (1838–1914), asserted that a burnt out specimen of giant sequoia had yielded **in excess**

of **4,000 rings**.^{24,25} The precise location of this specimen was never established and, therefore, the assertion remains unverified to this date. Nevertheless, the so-called **Grizzly Giant**, from the Mariposa Grove in Yosemite National Park, is believed to be **3,800 years old**!²⁶ The world-famous **General Sherman tree** is also thought to be older than the General Noble tree; **possibly as old as 3,500 years**.²⁷

Whilst the trunks of mature giant sequoias generally assume a cylindrical form, their relative girth (circumference) and diameter is seldom a reliable indicator of age. For instance, the so-called **Discovery tree** from Calaveras North Grove — acknowledged as one of the largest specimens of Sierra redwood ever reported — was only 1,300 years old when felled.²⁸ The diameter of the famous **Grant tree** (12.3 metres or 40.3 feet) — the second largest living tree — is nearly double that of the **Puzzle Corner tree** (6.9 metres or 22.5 feet); yet the Grant tree is said to be approximately 2,500 years old, whilst the Puzzle Corner tree is *slightly older*, at 2,760 years.²⁹ The General Sherman and General Noble trees, by way of comparison, have yielded diameters of 9.4 and 7.9 metres respectively.³⁰ The great antiquity of selected specimens of giant sequoia is, however, indicated by the presence of a snag-topped crown, massive branches which extend outwards and then upwards at great heights, and the absence of branches at lower elevations — natural pruning rendering the trunk branchless to a height of between 30 and 45 metres (100 to 150 feet).³¹

Under optimum growing conditions young Sierra redwoods will produce annual growth rings up to 12.7mm (or half an inch) thick.³² Newly formed rings will, as a rule, **decrease in thickness with increased age**.

Of particular interest is the fact that Sierra redwoods are **virtually indestructible**; the primary agents of destruction being forest fires, lightning strikes, erosional destabilisation, exposure to strong winds and, of course, the intervention of man (logging activities). Furthermore, **not one specimen examined to date has died of ‘old age’**. As Engbeck has noted:

*‘There does not seem to be any phase of a giant sequoia’s life span that can be termed ‘old age’ in the ordinary sense Even the oldest giant sequoias continue to grow rapidly, and sexual activity continues unabated. Theoretically it would appear that a giant sequoia could go on living and growing forever.’*³³

Despite the great antiquity of individual specimens of Sierra redwood, a reliable tree-ring chronology for *Sequoiadendron giganteum* extends backwards in time **only to 1250 BC**.³⁴ Why this should be so remains open to conjecture. (A possible explanation — within a creationist framework — will be offered later in this paper).

Bristlecone Pines

At the conclusion of a field trip through the mid-

western states of Utah and Idaho during 1952, Professor Frits Went and Dr Edmund Schulman of the California Institute of Technology decided to detour via the **White Mountains** of California (specifically the **Inyo National Forest**, at latitude 37°S), before returning home to Pasadena. Their reason for doing so was to follow through on persistent rumours that old trees existed there at elevations approaching 3,000 metres above sea level — the so-called **bristlecone pines** (*Pinus aristata* from Arizona, Colorado and New Mexico, and *Pinus longaeva* from the White Mountains, across the Great Basin of Nevada and into Utah^{35,36}). Preliminary sampling quickly confirmed the substance of the rumours.

The twisted and highly distorted trunk of the bristlecone pine — which often comprises a succession of new stems set at varying angles to one another — renders the establishment of reliable tree ring counts a painstaking and time consuming task. In fact, it has even been conceded that it is a ‘. . . *major puzzle to locate the early portion of the stem*’ (that is to say, the pith area nearest to its germination point)!³⁷

Nevertheless, by 1958 sufficient work had been carried out to establish the antiquity of **no less than 17 specimens ranging from 4,000 to 4,600 years old**; these specimens deriving from the western-most limit of the bristlecone pine’s range (the so-called ‘**Methuselah Walk**’ and nearby districts).³⁸ **The oldest living specimen of bristlecone pine is reputed to be approximately 4,900 years old** and derives from the Snake Ridge region of east-central Nevada.^{39,40} Exhaustive surveys of other specimens from the Snake Ridge, Mount Moriah, Ward Mountain and Schell Creek divisions of the Humboldt National Park followed. Although several specimens yielded ages in excess of 3,000 years, none exceeded 4,000 years — the oldest patriarch being 3,700 years.⁴¹

The girth of the largest bristlecone pine — the noble **Patriarch tree** — is approximately 12 metres. This is considerably less than the 32 metres attributed to the Grant tree.⁴² Yet, as in giant sequoias, size is seldom a reliable indicator of a tree’s age. For instance, the Patriarch tree is a mere 1,500 years old,⁴³ whilst a stunted ‘dwarf’ specimen with a 75mm (3 inch) trunk diameter and height approximating 900mm (3 feet) only has been shown to be no less than 700 years old.⁴⁴ Needless to say, the generally smaller trunk diameter of bristlecone pines yields a much more tightly packed section of annular rings than the giant sequoias (in fact, as many as 100 per centimeter).

Exhaustive studies by **Charles Wesley Ferguson** (1922–1986) and others at the Tree-Ring Laboratory at the University of Arizona (Tucson) have indicated that up to 10 percent of rings may be missing in extremely ‘sensitive’ specimens of bristlecone pine.⁴⁵ He has also asserted that multiple (or extra) growth rings are extremely rare in bristlecone pines.⁴⁶ This view has been **challenged experimentally by Lammerts**.⁴⁷

It is also significant that, in the oldest specimens of bristlecone pine, **growth has been exceedingly slow almost from the very first year, in contrast to larger, but younger, pines** (which show fairly fast growth in the early decades of life).⁴⁸ This possibly reflects the prevailing micro-site conditions under which the bristlecone pines grew (dry, cold, rocky limestone outcrops at high elevations).⁴⁹ On the other hand, it could also indicate that germination took place during a prolonged period of abnormal stress; that is to say, an extended period of less than optimum growing conditions. Such periods of stunted growth have also been documented in the recent past. For example, coincident with Europe's historic 'Little Ice Age' (AD 1650–AD 1710) there was a period during which the average growth rate for bristlecone pines **dropped to half its former value**.⁵⁰ It was during this same period that **many specimens succumbed to adverse growing conditions and died**.

Cores taken from a large number of living trees, eroded snags and sub-fossil remnants of bristlecone pines have been assembled into a number of distinct 'master' chronologies during the past three decades. Several of these chronologies now extend into the middle of the Holocene epoch, and no less than one into the early Holocene.

The first of the chronologies to be developed was assembled from paired cores taken from nine trees in the Methuselah Walk. The chronology extended backwards in time from the year AD 1962 to AD 1600.⁵¹

The second chronology to be developed became known as the **Schulman Master** (after Edmund Schulman). The chronology comprised cores from 14 White Mountains trees and extended from the year AD 800 to AD 1954.⁵² The chronology included the first bristlecone pine to be shown to be older than 4,000 years — **Pine Alpha** (or WHT-s 4759–A).

Early in 1968 Ferguson⁵³ made a preliminary announcement concerning the development of a 7,100 year-long continuous tree-ring chronology. In the same article Ferguson announced that a single specimen containing 400 rings had yielded a radiocarbon age of approximately 9,000 years BP.⁵⁴ Details of the **extended master chronology** were published by Ferguson in 1969.⁵⁵ The 7,104 year-long chronology represented an extension of the aforementioned Methuselah Walk and Schulman chronologies and utilised 22 sample cores taken from no less than 16 individual specimens.⁵⁶ In the same paper Ferguson alluded, once again, to the existence of a 9,000 year-old floating remnant, which lay beyond the limit of the extended master chronology. This time, however, the specimen was said to contain 498 rings.⁵⁷

Some three years (1972) later it was announced that the master chronology had been extended a further 1,149 years — as far back as the year 6291BC.⁵⁸ This was achieved using a further 17 cores taken from 13 specimens. Furthermore, the 'floater' referred to in the preced-

ing two papers by Ferguson, had acquired an extra ten rings.⁵⁹ In the same article (and a subsequent paper by Ferguson, Lawn and Michael⁶⁰) the remnant was identified as TRL 67–40.

In 1974 LaMarche and Stockton⁶¹ announced the development of a number of temperature-sensitive, upper treeline bristlecone pine chronologies across the American southwest. The longest of these — the **Campito Mountain** chronology — extended back some 5,405 years.

A further nine years were to pass by before the White Mountains master chronology was extended to 6700 BC,⁶² with TRL 67–40 still eluding cross-matching. Concurrent with the announcement of the extension of the master chronology, Ferguson and Graybill announced the development of a 5,238 year-long, continuous bristlecone pine chronology for east-central Nevada and the existence of a second, 500 year-long floater.⁶³ The new floater was subsequently accessioned TRL 81–228⁶⁴).

By 1985 the number of floaters eluding cross-matching had increased to three, following the discovery of a 602 year-long remnant in 1984 (H–84–1).⁶⁵ The three floaters remain beyond the limits of the existing master chronology and do not overlap one another in any way. Radiocarbon dating of all three floaters suggests that they fall within a tentative timeframe of 7500 BC to 9000 BC.⁶⁶

Long-Lived Trees from Central America

Many extravagant claims have been made over the years concerning the age of a particular **Mexican Bald Cypress**, *Taxodium mucronatum*, located near the city of Oaxaca. The tree in question is located in a churchyard in the township of **Santa Maria Del Tule** (approximately 420 kilometres southeast of Mexico City and at a latitude of approximately 17.5°N). The **New Age Encyclopaedia** consigns an age of 6,000 years to the tree.⁶⁷ However, following an examination of the cypress Schulman concluded that its size:

*'... inspires enthusiastic overestimates of age. ... if we judge by the growth on a wind-felled branch, measurements of increase in girth of the stem, and the plentiful water supply, an estimate of 1,500 years is very optimistic, even if this is not the triplet tree it is believed to be.'*⁶⁸

Long-Lived Trees from Europe and Britain

The genus *Quercus* (or **oak**) comprises approximately 450 distinct species of tree — spread throughout the Northern and, to a lesser degree, Southern Hemispheres. Several species live to great ages, including the predominant European species, *Quercus robur* — otherwise known as the **English, brown or common oak**. Indeed, the **New Age Encyclopaedia** suggests that: *'They reach a great age, sometimes over a 1,000 years, and perhaps more'*,⁶⁹ whilst the **Encyclopaedia Britannica** suggests that: *'... many of the largest trees still standing*

in the British Isles are believed to date from Saxon times';⁷⁰ that is to say, from between AD 450 and AD 800. Jacobs has also noted that: 'Some oaks live 1,500 years.'⁷¹

However, as is the case in most regions of the earth, the honour of the oldest living trees in Britain and the Continent belongs to an endemic conifer from Britain — the yew.

The Yew

The European evergreen, *Taxus baccata*, is another tree which lives to great ages. Jacobs⁷² has consigned this conifer to longevity Group 5; that is to say, trees with a potential longevity in excess of 2,000 years. Indeed, a yew tree found in a churchyard in the Scottish village of Fortingall was claimed by locals to be 3,000 years old, although this may have been an exaggeration.⁷³ Nevertheless, the tree is said to have possessed a girth of approximately 17 metres (or 56 feet) as long ago as 1772, before the trunk split in two.

Despite the fact that the longevity of the European yew is significantly greater than either of the predominant European species of oak — *Quercus robur* and the **durmast oak**, *Quercus petraea* — most dendrochronologists favour the oak for the construction of extended tree-ring chronologies. Because the average life expectancy for these oaks is only of the order of 150 to 250 years,⁷⁴ a substantially greater number of individual specimens is needed to construct a long chronology than is the case with the bristlecone pine. (By way of comparison, the average life span for the bristlecone pine is 1,000 years or more and, hence, fewer specimens are required to construct the extended master chronology.)

In 1984 Pilcher *et al.*⁷⁵ described the development of a 7,272 year-long oak continuous chronology. This master chronology comprised a number of Irish and German tree-ring chronologies, linked together following detailed cross-matching analysis. These chronologies comprise large numbers of **subfossil bog oaks** and **archaeological timbers**.⁷⁶ The chronology has since been extended to 9,928 years, or virtually to the boundary between the Pleistocene and Holocene epochs.⁷⁷

In addition to the aforementioned master chronology, a 1,604 year-long 'floating' chronology — comprising subfossil remnants of **Scots pines** (*Pinus sylvestris*) from various alluvial river terraces in south central Europe — has also been developed.⁷⁸ Radiocarbon datings for the pine chronology range between 8,930 BP and 10,030 BP.⁷⁹ A relationship between the pine and oak chronologies has been (tentatively) established by means of the radiocarbon datings of each and an inferred transitional oscillation at approximately 9,800 BP.⁸⁰ Furthermore, Becker *et al.*⁸¹ have inferred a notional timeframe for the late Glacial/Holocene boundary based on percentage variations in **stable isotopes** such as carbon-13 (¹³C) and deuterium (²H) in the sampled timbers. This boundary has been tentatively set at a minimum age of 10,970 dendro-years.

Curiously, **no significant changes were observed in the long-term tree-ring growth rates of the pines.**⁸²

Long-Lived Trees from South America 'Alerce' or *Fitzroya cupressoides*

Whilst the North American continent is home to several tree species exhibiting great longevity, the southern Andes of South America are also home to several long-lived, cold rainforest evergreen species of tree, including *Fitzroya cupressoides* (known locally as the **alerce**) and the southern beech, *Nothofagus betuloides*.

The former of these two, which is regarded by Schulman⁸³ as being very similar to the coastal redwoods of California, was named after Robert Fitzroy (1805–1865), a one-time captain of HMS Beagle who later became first director of the Meteorological Office and Governor of New Zealand from 1843 to 1845.

A limited forest sampling survey conducted by Schulman revealed a number of specimens **in the 2,000 year class**. However, he also noted that these ages were '... **only about half the reputed maximum**'.⁸⁴ The largest specimen examined by Schulman — the 'Silla del Presidente' — is found near Puerto Montt, in Southern Chile. The tree possessed a diameter of 3.0 metres (10 feet) immediately above the basal flare.⁸⁵

The Southern Beech

The slow growing evergreen rainforest tree, *N. betuloides*, is confined to fiord-like topography of the western slopes of the Chilean Andes. (They are not to be confused with the Antarctic beech, *N. antarctica*, a deciduous tree, which is largely confined to the southernmost regions of Chile). According to Francis⁸⁶ some specimens have been shown to range in age between 1,500 and 2,000 years.

Australasia and South-East Asia

On the opposite side of the Pacific Ocean the Australian continent plays host to many native species of eucalypt. Numerous tree-ring studies over the years have revealed few eucalypts with any dendrochronological potential — the equable climate often resulting in indistinct and non-annular rings.

The island state of Tasmania and the mainland state of Victoria are home to a native eucalypt, the **mountain ash**, or *Eucalyptus regnans*. The largest living mountain ash is 99 metres (324 feet) high. However, the tallest recorded Tasmanian specimen stood some 114 metres (375 feet) high, before being chopped down by lumberjacks. Though rivalling the heights of redwoods, these native eucalypts fall way short of the ages attained by the Californian redwoods — the oldest specimen on record living to an age of only 300 plus years.⁸⁷

Another native eucalypt, the **Karri** tree from southwestern Australia (*Eucalyptus diversicolor*), is also notable for its height — the largest living specimen standing

some 88 metres (288 feet) tall. Nevertheless, because of the generally poor quality of Australian soils and the tree's susceptibility to insect predation, the Karri tree seldom lives to more than 500 years in age.⁸⁸ So whilst both of the aforementioned species grow to heights comparable with those of coastal and giant redwoods, they never mature ('fatten') in the same manner as the long-lived American patriarchs.

Individuals of several other eucalypt species — including the **Jarrah**, *E. marginata*, and the **River Red Gum**, *E. camaldulensis* — do manage to live to ages of around 1,000 years under ideal growing conditions. Nevertheless, Jacobs⁸⁹ has noted that, whilst it is possible that jarrah and red gums could be placed in Group 4 (that is, trees with a potential longevity of between 1,000 and 1,500 years), '... it is doubtful if any eucalypts could become really old trees.'

On the other hand, Tasmania is also home to a number of long-lived conifers including the **King Billy pine** (*Athrotaxis selaginoides*), the **Pencil pine** (*A. cupressoides*) and a putative hybrid (*A. laxifolia*), the **Celery Top pine** (*Phyllocladus aspeniifolius*) and the **Cheshunt pine**, *Diselma archeri*. All are generally restricted to high altitude regions of central and western Tasmania. Core samples taken from stands of each species have identified a number of individual specimens with ages in excess of 1,000 years.⁹⁰ For instance, pencil pines from the eastern flanks of Cradle Mountain have been dated at 1,400 years,⁹¹ whilst sound logs on the forest floor and standing dead trees from the nearby Waldorfer Forest have produced radiocarbon ages ranging from $1,275 \pm 105$ to $1,715 \pm 140$ years BP.⁹² However, the oldest conifers in Tasmania belong to a single species of the genus *Lagarostrobos* — the **Huon pine**, *L. franklinii* (formerly *Dacrydium franklinii*) — an endemic species which appears to match (and exceed) the longevity of the coastal redwoods and may yet rival the ages of some of the oldest giant redwoods.

Huon Pines

As the name implies, the Huon pine is a native conifer. It is regarded as the oldest of the Australian conifers; a species which has clearly defined, but extremely complacent, annular rings. There is a relatively low incidence of false rings in Huon pines, which renders them ideal for dendrochronological studies.

The species is confined largely to the river valleys of western Tasmania — between latitudes 41.5°S and 43.5°S. Logging operations decimated many of the stands of Huon pine during the early years of white settlement — 'piners' not only extracting the trees from the alluvial river banks and valley floors, but also the nearby slopes.⁹³ Indeed, Ogden⁹⁴ has noted that:

'... the species is now **much reduced in occurrence**, due first to logging and more recently to hydroelectric power generation schemes, and **the majority of old**

individuals have been destroyed.'

In 1980 Dunwiddie and LaMarche⁹⁵ reported the existence of one particular specimen with over 2,000 rings, and suggested that this species '... probably includes the oldest trees in Australia'. The particular specimen in question — which was felled during salvage operations for the Hydro-Electric Commission's Upper Gordon Power Development project and which derived from the Pearce River Valley in southwestern Tasmania — yielded a **ring-count age of 2,157 years**.⁹⁶

More recent studies of other stands from central west Tasmania have revealed *potentially* older specimens of Huon pine. For instance, Peterson⁹⁷ discovered a specimen from the Lower Gordon River Valley during 1982/1983 with a trunk diameter of 2.97 metres. The specimen has been given an **inferred age of 3,450 years** (based on average age/diameter relationships for the species). However, the trunk of this tree was largely hollow. Therefore, the assessed age must be treated with a certain degree of caution.⁹⁸

Nevertheless, a 1.96 metre diameter specimen discovered by Peterson in the Harman River Valley (north of Zeehan) during 1988 is thought to be solid to pith. A 60cm core from this tree revealed no less than 1,987 rings — suggesting that the tree's age **may be in the order of 2,500 years**.⁹⁹ An attempt is to be made to obtain a core section to pith in this particular specimen and, according to Peterson, it is anticipated that this will affirm it as the '... **oldest confirmed living organism in Australia (and probably the Southern Hemisphere)**.'¹⁰⁰

However, other authorities have argued that this honour belongs to either the negrohead beech or brush box trees of Eastern Australia.

A Huon pine master chronology is currently being developed for the Mount Reid/Lake Johnston region of northwest Tasmania. The trees from this region — both living and dead — represent the upper limit to the Huon pines geographic range. By 1991 the chronology extended back as far as AD 900, making it one of, if not the longest (oldest), tree-ring chronology in the Southern Hemisphere.¹⁰¹ The chronology has recently been extended to 2,290 years.¹⁰²

Negrohead or Niggerhead Beech Trees

During a recent vacation in south-east Queensland (Australia) the author happened upon information concerning the existence of trees of great antiquity in the **Lamington National Park** (specifically in the **McPherson Range**). These evergreen trees — often called 'Antarctic' beeches, but more correctly described as **negrohead** or **niggerhead beeches** (*Nothofagus moorei*)^{103,104} — are confined to the rainforest regions of the Park, especially along the top of the border escarpment between Queensland and New South Wales (where elevations approach 1,200 metres above sea level and rainfall is plentiful).

Some of the tallest specimens are to be found in the

vicinity of Mt Merino (between Binna Burra and O'Reilly's), and are thought to be possibly 3,000 years old.¹⁰⁵ The roots of another patriarch, located on the Border Track between Bithongabel and Toolona Look-outs, **are said to be approximately 5,000 years old!**¹⁰⁶

The species extends from the subtropical rainforests of the McPherson Ranges in southeastern Queensland (latitude 28°S) southward to the **Barrington Tops State Forests** of New South Wales (latitude 33°S).

It has proven extremely difficult, if not impossible, to arrive at reliable ages for these trees either by means of tree ring counts or carbon-14 dating techniques (since in rainforest regions the heartwood of the trunk is usually rotten). Indeed, in older patriarchal specimens the original tree trunk no longer exists, having been replaced by a succession of younger trunks.

The negrohead beech regenerates primarily by vegetative means (suckering). The butt, or base of the trunk, is often elevated above the ground and enlarged, with many small adventitious shoots. According to Boland *et al.* the

*'... stages of development can be seen extending through the presence of several subsidiary stems around the original one, to circular groups of stems surrounding a gap where the original one has died and rotted away.'*¹⁰⁷

The root system sends up coppice shoots following the demise of the primal trunk. The shoots subsequently develop into 'replacement' trunks. The same process is repeated a number of times until one ends up with a circle of trees surrounding a void (where the original trunk originally grew).

Attempts to date selected specimens of negrohead beech from the Lamington National Park have proven unsuccessful.¹⁰⁸

The previously cited ages for certain patriarchal trees have derived from *comparative* studies of the regenerative development of patriarchal specimens in reference to younger (primal) trees.

Suffice to say that there are doubts concerning the great ages ascribed to so-called patriarchal specimens of negrohead beech.¹⁰⁹ Indeed, the theoretical basis to such claims (that is, the vegetative reproduction of the species) has been described by Gillespie¹¹⁰ as being largely anecdotal in nature. Therefore, we must reserve judgment on these claims of great longevity for the time being.

Brush Box

The **brush box**, or *Lophostemon confertus* (formerly *Tristania conferta*), is found in the **wet sclerophyll forests** of eastern Australia; stretching from as far north as Port Douglas in Queensland (latitude 17°S) to the Port Stephens region of New South Wales (latitude 33°S).

Great ages have been assigned to selected specimens of this species. However, age estimation is made difficult by the lack of distinct annular rings in the species. Four

selected trees from Terania Creek (**Whian Whian State Forest**) in northern New South Wales yielded radiocarbon ages and trunk diameters as follows: 110 years (80 cm); 480 years (120cm); 1,060 years (155cm) and 1,340 years (160cm);¹¹¹ results consistent with a trend of diminishing annular growth with increased age and senescence.

Larger specimens are to be found in Queensland's Lamington National Park and the neighbouring area of New South Wales. A 40 metre high specimen, with a trunk diameter of approximately 2 metres, is to be found in the Giant's Garden section of the Park's **Box Forest Circuit**, whilst individual specimens from the Giant's Garden are thought to be up to 1,200 years old.¹¹² However, the largest (and probably oldest) brush box in the Park is found on a very steep and undesirable growth site adjacent to the popular **Picnic Rock** track. This patriarch possesses a girth of approximately 13 metres (and diameter of 4 metres) at breast height.¹¹³ The largest specimen from the neighbouring state of New South Wales, by way of comparison, measures 3.17 metres in diameter.¹¹⁴ Direct comparison with the smaller (and presumably younger) specimens from the Box Forest Circuit and Terania Creek would seem to indicate ages for these largest living patriarchs well in excess of 2,000 years.

New Zealand Kauri Trees

The oldest living trees in New Zealand are thought to be the kauri pines (or *Agathis australis*). In fact, Dunwiddie¹¹⁵ has suggested that chronologies constructed from both Maori artifacts and subfossil specimens from bogs '*... could (eventually) rival in length those of the bristlecone pine (Pinus longaeva) in the United States, and the oak (Quercus) in Europe.*'

The kauri is confined to a relatively narrow band of the North Island of New Zealand — between latitudes 35.5°S and 38°S.

The **Waipoua State Forest** on the North Island of New Zealand is home to one of the largest remnant stands of kauri in the southern hemisphere. These trees, which are found throughout South-East Asia, northeastern Australia and the North Island of New Zealand are, in many respects, reminiscent of the cedars of Lebanon. Mature kauris grow to great heights (up to 37 metres on average) and feature equally impressive trunks (up to 4.5 metres in diameter).

Several specimens from the Waipoua State Forest are worthy of our attention. The first and perhaps most familiar specimen to visitors to the State Forest — **Tane Mahuta** (in the native Maori tongue) or 'God of the Forest' — is estimated to be 1,200 years old.¹¹⁶ It stands 51 metres (169 feet) tall, with a circumference of 13.4 metres (44 feet) at mid-girth and a height to its first branch of 9.4 metres (31 feet).

A second, and somewhat smaller, though 'fatter' specimen — **Te Matua Ngahere** (or 'Father of the For-

est') — is thought to have an age approaching 2,000 years.¹¹⁷ With a height approaching only 30 metres (98 feet) and a mid-girth of 16.1 metres (53 feet), this specimen is not quite as straight nor as impressive as its taller relative, **Tane Mahuta**.

Nevertheless, these trees are but a shadow of those living in the Forest during the last century — before logging and gum-digging operations stripped the region of many of its bigger specimens. For instance, Bircham¹¹⁸ describes a kauri tree from the Waipoua region — which was still alive in 1879 — as having measured some 30 metres (100 feet) to its first limb and was **judged to be twice the size of Tane Mahuta**.

Elsewhere, in the Kaihu Valley of the Northern Wairoa Hills, it is said that there were:

‘. . . numbered among its mature kauri stands some giants **beside which Tane Mahuta is a mere callow youth**. One such tree, it is recorded, measured seventy-five feet (23 metres) to its lowest branch, and had a circumference of seventy-eight feet (24 metres).’¹¹⁹

It was destroyed by a forest fire.

Another kauri tree, from the Coromandel Peninsula region of the North Island, measured 32 metres (or 106 feet) to its lowest branch and **with a girth of approximately 23 metres**.¹²⁰

One can now only speculate at the possible ages of such patriarchs. Nevertheless, maximum ages ranging from three to possibly four millennia do not appear altogether unrealistic, given comparisons with living (and younger) patriarchal specimens and the tendency for rings to narrow with increasing age and the onset of senescence in the tree.

Long-Lived Trees of Africa

According to Curtis *et al.*¹²¹ the only two genera known to live more than 700 years in southern Africa are the indigenous conifer, *Podocarpus* (in particular, the plum fir or **plum-fruited yew** *P. falcatus*), and the angiosperm, *Adansonia digitata* (Monkey Bread or **baobab** tree). The second long-lived indigenous conifer, *Widdringtonia cedarbergensis*, has been inferred by the same authors to be of lesser value to the dendrochronologist than *Podocarpus* because of the lack of an abrupt termination in latewood growth.¹²² Nevertheless, *Podocarpus* also suffers from faint rings and an ever-present susceptibility to **lobate growth** (that is, ‘wedging’ of the tree rings).¹²³

The South African Mountain Cedar (*Widdringtonia cedarbergensis*)

In 1980 Dunwiddie and LaMarche¹²⁴ noted that: ‘. . . little dendrochronology related work of any sort (had) been done on the African continent.’ They then went on to describe a particular species of conifer, *Widdringtonia cedarbergensis*, which, they suggested, ‘. . . seemed to

offer particular promise by virtue of its apparent great age, its tree-ring properties, and its occurrence in marginal habitats of the Cedarberg Mountains’, some 200 kilometres north of Cape Town.¹²⁵ The maximum age of living specimens is not known at the time of writing.

LONGEVITY OF TREES: RELEVANCE TO EARTH HISTORY

According to a ‘tight’ chronology of earth history (based on the Massoretic text of the Old Testament), the biblical Flood occurred some 4,300 years ago. The duration of this epoch would be extended by some 780 years to approximately 5,100 years were the Septuagint (LXX) text to be followed. The Flood, in turn, was followed almost immediately by an intensifying period of colder climatic conditions at mid to high latitudes, this period ushering in a single, post-Flood Ice Age lasting perhaps 400 and 700 years.¹²⁶

Putting aside the claims of extended bristlecone pine and oak chronologies for the moment, it is not without significance that the earth’s oldest living trees — the bristlecone pines from the American southwest (and perhaps the negrohead beeches of eastern Australia) — are estimated to be between 4,000 and 5,000 years old. Given that the estimated ages of these trees may be overstated, it is not beyond the bounds of possibility that these ancient, but still living, patriarchs were amongst the first trees to germinate after the biblical Flood or the great (Pleistocene) Ice Age.

Furthermore, as has already been noted, the oldest confirmed living specimen of Sierra redwood is at least 3,800 years old. It remains possible that there are other living specimens older than 4,000 years, since at least one specimen from the recent past is reputed to have lived to an age in excess of 4,000 years.

Collectively, the ages of these oldest living specimens of bristlecone pine, giant sequoia and, possible, negrohead beech trees, though few in number, seem to point to a ‘ceiling’ in the longevity of modern trees of less than 5,000 years. The significance of such a ceiling, together with the giant sequoia’s seeming immunity to the ravages of time and senescence, did not escape Schulman. In his 1954 **Science** paper entitled ‘Longevity under Adversity in Conifers’ Schulman stated:

‘Perhaps the most intriguing of the unanswered questions regarding longevity in conifers has to do with Sequoia gigantea trees, which, some believe, may enjoy perpetual life in the absence of gross destruction, since they appear immune to pest attack. . . . Pertinent also is the well-known fact that standing snags of this species, other than those resulting from factors of gross destruction, are unknown. **Does this mean that shortly preceding 3,275 years ago (or 4,000 years ago, if John Muir’s somewhat doubtful count was correct) all the then living giant sequoias**

*were wiped out by some catastrophe?*¹²⁷

Of course, it wasn't long before Schulman's 'catastrophic' explanation came under severe criticism.

Wagener, for instance, stated that:

*'... it hardly seems necessary to suggest, as Schulman has done, the possibility that all then living specimens were wiped out by some catastrophe 3000 to 4000 yr ago. The end for these forest giants comes when reduction in root systems through deterioration reaches a point at which the tremendous bulk of trunk and top can no longer be mechanically supported, and they fall. This accounts for the lack of standing sequoia snags on which Schulman has remarked.'*¹²⁸

Now although Schulman¹²⁹ conceded that Wagener's explanation seemed 'well-based', it is interesting to note that the fossil record of the Sierra Nevadas has yielded very little information concerning the species' presence in the region since the time of glacial maximum during the Late Pleistocene Ice Age.¹³⁰

Furthermore, the inability of dendrochronologists to extend the chronology for giant sequoias beyond the present-day limits of longevity for the oldest living specimens suggests that older, eroded trees or subfossil fragments from sites of living stands are **either lacking or non-existent**. Were the latter to be established beyond doubt, it would provide a measure of *prima facie* evidence for a relatively recent restoration of the species following a major cataclysmic event or climatic shift.

But what of trees that were alive at the time of the Flood?

Specimens from the Time of the Flood

It is interesting to note that all three living genera of sequoia — the dawn redwood (*Metasequoia glyptostroboides*), the coast redwood (*Sequoia sempervirens*) and the giant redwood (*Sequoiadendron giganteum*) — were **present in large numbers at the time of the great Mesozoic extinctions and shortly thereafter**;^{131,132} that is to say, immediately preceding, and for some time after, the so-called K/T boundary.¹³³

The earliest specimens of redwood date from the Jurassic period.^{134,135} Specimens of dawn and coast redwoods have frequently been found in Cretaceous deposits throughout the northern hemisphere — North America, Greenland, Iceland, Europe and Central and Eastern Asia. On the other hand, giant redwoods from the Cretaceous period were largely confined to North America, Greenland and Europe.¹³⁶

Fossilised remains of bristlecone pine are known to exist in deposits of Tertiary age.¹³⁷

Likewise, the fossilised remains of negrohead beech tree and Huon pine pollens date from late Cretaceous deposits in Eastern Australia.¹³⁸ Fossilised pollen spores from trees belonging to the family **Myrtaceae** — which includes the brush box (*Lophostemon confertus*) — date from the early Palaeocene.¹³⁹

Finally, the fossilised remains of kauri leaves and cones are dated as early as the Jurassic period in Australia and New Zealand.¹⁴⁰ On the other hand, subfossil kauri woods have been recovered from bogs dating back as far as 40,000 years BP.¹⁴¹

The fact that all six of these long-lived trees appear in late Mesozoic or subsequent Tertiary deposits may provide us with a pointer as to the nature and timing of their origins.

The 'Floating Mat' Hypothesis and 'Fossil Forests'

In 1979 Dr Steve Austin, a creationist geologist and lecturer at the Institute for Creation Research, devised a catastrophic explanation for the origin of coal — his so-called '**floating mat hypothesis**'.^{142,143}

According to Austin's model, the catastrophic conditions prevailing at the time of Noah's Flood would have led to the formation of vast mats of floating tree trunks. The tree trunks would have buffeted against one another, stripping the trunks of their branches, leaves and bark. The leaves and bark would quickly become water-logged and settle to the ocean floor — **becoming the ingredients for fossil coal**. The logs, however, would remain afloat for a longer period of time. Nevertheless, they, too, would eventually become water-logged and sink to the bottom of the ocean, to be covered by ensuing deposits of Flood sediments.

Petrified Forest National Park

The Petrified Forest National Park is located some 165 kilometres east of Flagstaff (Arizona) and is situated at latitude 35°N. It is significant that the fossilised tree trunks found in the National Park are **devoid of branches and most of their bark**.¹⁴⁴

Whilst most of the fossilised sequoias are found in a prone position, there are also a few upright stumps to be found in the Petrified Forest.¹⁴⁵ The horizontal logs from the Park's Chinle Formation exhibit a strong preferential orientation — suggesting an allochthonous (water-transported) origin.¹⁴⁶

Furthermore, most of the logs have yielded diameters of between 0.9 and 1.2 metres (3 to 4 feet), although a few exceptional specimens have measured up to 2.1 metres (7 feet). These same logs have measured up to 38 metres (125 feet) in length.¹⁴⁷ In terms of both height and diameter, these petrified sequoias are significantly smaller than their modern-day descendants. For instance, Breed — in reference to the fossil-bearing Cretaceous deposits of northern Arizona (including the Petrified Forest National Park) — notes that:

*'Conspicuous among the conifers was the Sequoia; although none was so large as the modern Californian giants . . .'*¹⁴⁸

Could this indicate that the sequoias that died during the Mesozoic era **were yet to attain the ages of their**

oldest living descendants (remembering that the interval between the creation of the world and the Flood was only 1650 years or thereabouts, whereas the post-Flood epoch has been of at least 4,300 years duration)? Does it follow that the suppressed ages of sequoias — which were distributed widely throughout the northern hemisphere during the Mesozoic era — and other long-lived trees are mirrored at other ‘fossil forest’ sites throughout the northern and southern hemispheres?

Florissant Fossil Beds National Monument

A similar situation exists amongst the fossilised sequoias of the Florissant Fossil Beds National Monument in the state of Colorado and at latitude 39°N. Kathryn M. Gregory, formerly of the Department of Geosciences at the University of Arizona (Tucson) and now with the Lamont-Doherty Geological Observatory at Palisades (New York), has recently carried out a survey of nine sequoia specimens from purportedly early Eocene deposits at the Florissant locality. These specimens are thought to be most closely related, though not necessarily ancestral, to the coastal redwoods of California, *Sequoia sempervirens*.¹⁴⁹ The oldest of the nine specimens (which she suggests was **possibly 1,500 years old** when it died) possessed a circumference approaching 15 metres (or 50 feet).¹⁵⁰

The fossilised sequoias at Florissant — like those at Petrified Forest National Park — are **virtually devoid of bark**. Furthermore, there appears to be **no evidence of the presence of frost rings** in the samples examined by Gregory, although she cautions that that may be due to destruction of the same by post-burial deformation.¹⁵¹ **At least two of the nine sequoias examined cross-dated**, suggesting that (at least) these two trees grew contemporaneously.¹⁵²

As we shall see shortly, Austin’s model is also capable of accounting for the petrified remains of ‘successive forests’ at **Amethyst Mountain, Specimen Ridge** and several other sites in the northeastern corner of Yellowstone National Park. The model places these Tertiary (Eocene) formations and their purportedly *in situ* fossils within a Flood context.

Yellowstone National Park ‘Fossil Forests’

Yellowstone National Park is located in the north-western corner of the state of Wyoming and between latitudes 44°N and 45°N.

Most of the petrified remains of tree stumps from Amethyst Mountain range in diameter from 0.6 metres to 1.2 metres (2 feet to 4 feet).¹⁵³ However, Knowlton has noted that the largest preserved trunk yielded a diameter of a little more than 3 metres (10 feet).¹⁵⁴ This poorly preserved specimen was thought to be related to the coast redwoods.¹⁵⁵

The petrified remains of many specimens of the redwood, *Sequoia magnifica*, are to be found on the upper

slopes of Specimen Ridge. These redwoods also vary in trunk diameter up to a maximum of 3 metres.¹⁵⁶ Most, if not all, of these redwoods are regarded by Ammons *et al.* as being ‘... **anatomically indistinguishable from the modern coast redwood** (*S. sempervirens*).’¹⁵⁷ On the other hand, some of the larger specimens have been described as giant (as opposed to coastal) redwoods. For instance, Knowlton¹⁵⁸ noted the existence of an extremely well-preserved and petrified **giant redwood** from the Specimen Ridge area of the National Park, one which possessed a circumference of 8 metres (26.5 feet).

Most authorities refer the Yellowstone fossil redwoods to a single species, *Sequoia magnifica* (Knowlton, 1899). However, one of America’s foremost dendrochronologists, Andrew Ellicott Douglass (1867–1962), referred some 38 samples collected during 1936 **from a single horizon of petrified trees** at Specimen Ridge to a different species, *Sequoia langsdorfii*.¹⁵⁹ Arct¹⁶⁰ refers these same specimens to the genus *Sequoiadendron*. The presence of more than one fossilised species of redwood at Yellowstone National Park (which is found in the north-west corner of the midwestern state of Wyoming) would not be altogether surprising given the presence of fossilised remains of giant sequoias, *Sequoiadendron*, throughout the neighboring state of Idaho. These redwoods are usually referred to the taxon *Sequoiadendron chaneyi* and are regarded by Engbeck¹⁶¹ as ‘... *virtually identical to ... present-day giant sequoia*.’ The difficulty in discriminating between coastal and giant redwoods — especially when examining fossilised remains — is compounded by the fact that the wood of young Sierra redwoods is very much like that of coastal redwoods. The distinction only becomes greater as the Sierra redwood ages — when the giant redwood timber becomes drier, lighter and more brittle.

Concerning the ages of some of the petrified redwoods, a second and somewhat smaller redwood specimen from the same locality (diameter 1.5 metres, or 5 feet) is described by Dorf¹⁶² as having been **about 1,000 years old at the time of its burial**, whilst a stand of petrified trees from the so-called ‘**Fossil Forest**’ on the northern face of Amethyst Mountain, some seven kilometres south-east of Specimen Ridge, have yielded as many as 500 annual growth rings, only.¹⁶³ Field examinations by Ammons *et al.*¹⁶⁴ of no less than six specimens of *S. magnifica* from the Lamar River Formation of Specimen Ridge yielded ages ranging from 100 years to 170 years only. Such counts suggest again that all of the aforementioned trees (like their redwood relatives from Amethyst Mountain) were **far from ‘mature’ specimens at the time of their demise**.

Now Specimen Ridge, located on the southern side of the Lamar River Valley, is said to have formed as a result of glacial action towards the end of the Tertiary period — some 2.5 million years ago — and throughout the subsequent Quaternary period.¹⁶⁵ In terms of a Flood model,

this would coincide with a single, post-Flood Ice Age. The petrified remains of many trees were exposed after deglaciation and as a result of further erosion of the sidewalls of the present-day valley.

Many writers have argued that the 27 stacked ‘fossil forests’^{166–168} at Specimen Ridge demand a formative timescale substantially longer than a tight biblical chronology would allow.

One such writer is physicist, Dr Alan Hayward. In his book **Creation and Evolution — The Facts and the Fallacies**¹⁶⁹ Hayward affirms the legitimacy of arguments against early creationist explanations for the fossil forests at Specimen Ridge and Amethyst Mountain (in particular, those of Whitcomb and Morris¹⁷⁰). He refers to two papers outlining the findings of separate site inspections by leading authorities on the fossil forests — the first by palaeontologists Richard and Stephen Ritland,¹⁷¹ and the second by geologist William Fritz.¹⁷² Both papers are said to deny the possibility of an **allochthonous** (water-transported) explanation for the origin of the stacked forests. They thereby invoked an **autochthonous** (*in situ* growth) explanation for the origin of the fossil forests.

However, it is interesting to note that Fritz subsequently wrote a second paper on these same ‘fossil forests’¹⁷³ — one which called into question the notion of *in situ* burial of living forests. In the latter paper he suggested that the petrified tree stumps were **moved by high-energy fluvial processes**. They were then deposited right-side-up before being buried in conglomerates and, to a somewhat lesser extent, sandstone and ash sediments.¹⁷⁴ Fritz also noted that the horizontal logs were, as a rule, oriented (preferentially) in a particular direction — as if having derived from a log jam.¹⁷⁵ Furthermore, he observes that:

*‘During transport, roots and branches were broken off. The flows also debarked the trees, adding a mud casing. . .’*¹⁷⁶

Even the petrified sequoias — **which are noted for their thick and resistant casing of bark** — suffered the same fate as other types of flora.¹⁷⁷

In reference to Fritz’s paper,¹⁷⁸ Austin¹⁷⁹ has noted that:

‘These rapid processes are believed to have occurred on the flanks of volcanoes, producing a complex series of sedimentary rocks where no “forest” or depositional layer exists that can be traced for any distance, and helps explain mixing of plants from differing ecological zones.’

In fact, the diversity of plant fossils is said by Fritz to be ‘... **extreme, even for a Paleogene flora**’ and ‘... seems to be out of place for “forests” interpreted as having been buried in place with little or no transportation.’¹⁸⁰ In a still later paper, Fritz¹⁸¹ reinforced this view, stating that:

‘... the mixture of trees from cool-temperate to tropical environments, along with an analysis of the

sedimentary structures and stratigraphic framework, indicates an environment where considerable transport occurred.’

(It should be noted that Fritz^{182,183} has since attempted to play-down the significance of water transportation in the formation of the Yellowstone ‘fossil forests’; especially after separate criticisms by Retallack¹⁸⁴ and Yuretich.^{185,186} Indeed, in his comments on Yuretich’s 1984 paper Fritz¹⁸⁷ goes to great pains to point out that he: ‘... never proposed that any of the stumps and logs in Yellowstone were transported for a long distance **by a major flood**’ — for to do so would be to invoke a catastrophic explanation for the ‘forests’. Such a view is anathema to the evolutionary geologist. Nevertheless, it is significant that even Yuretich concedes that:

*‘These forests are not neatly arranged in layer-cake fashion as . . . previous authors (such as Holmes and Dorf) implied; rather, only isolated parts are preserved haphazardly according to the vagaries of the prevalent sedimentary processes.’*¹⁸⁸)

Austin’s ‘floating mat’ hypothesis complements the earlier conclusions of Fritz by providing a credible explanation for the so-called ‘fossil forests’ — one requiring a catastrophic and allochthonous origin. The fact that the tree stumps are right-side-up is readily explained by both Fritz¹⁸⁹ and Austin¹⁹⁰ as being a consequence of the greater mass of the tree trunk base and the breadth of the associated root ball mass.

It has been suggested earlier that there would have been a time delay between the initial destruction of the fossil forests and their subsequent burial upon becoming water-logged. This delay suggests that the ‘fossil forests’ of Yellowstone National Park were formed late in, or possibly even some time after, the Flood year. Furthermore, if the notion of a global catastrophe, such as that described in the book of Genesis,¹⁹¹ were to be considered, then it is highly unlikely that we would anticipate finding the fossilised remains of terrestrial vertebrates this late in the catastrophe and in the same deposits as the so-called ‘fossil forests’. A possible affirmation that this was, indeed, the case is to be found in the observations of Dorf.¹⁹² He has noted that:

‘Although the remains of a few fossilised bones and teeth have been collected from volcanic rocks east and south of Yellowstone Park, no animal remains have ever been found in the volcanics within the park.’

The substance of the prediction is further affirmed when one considers the fluvial nature of deposition and the depth (366 metres, or 1,200 feet¹⁹³) of the deposits in which the ‘fossil forests’ were buried.

Furthermore, tree ring studies by Arct¹⁹⁴ have provided a measure of support for the notion of a rapid and largely contemporaneous burial of fossil forests at Specimen Ridge. His investigations of 28 trees from no less than seven distinct levels (so-called ‘living floors’) have

revealed a recurrent ‘signature’ in the peripheral (outermost) rings of at least seven specimens deriving from three successive levels.¹⁹⁵ He concluded that:

*‘If indeed, trees containing the signature are located on separate levels, it would indicate that at least those “forests” are not (emphasis mine) in situ The presence on more than one level of trees which grew contemporaneously suggests the possibility that the entire sequence may have been a transported assemblage.’*¹⁹⁶

More recently, Ammons *et al.*¹⁹⁷ have identified a characteristic ring signature in *Sequoia magnifica* specimens from a ten metre thick low-energy facies at Specimen Ridge. The co-authors of the paper — including William J. Fritz — conclude (correctly) that the existence of the ring signature demonstrated that the tree stumps were growing contemporaneously in the same forest. However, they then go on to cite the presence of this signature (rather presumptively) as evidence for *in situ* burial.¹⁹⁸ (The presence of a characteristic ring signature is, however, irrelevant when it comes to determining whether the trees are *in situ* or of allochthonous origin.)

Unlike the samples taken by Arct, those by Ammons *et al.* derived from an area close to the centre of the tree stumps.¹⁹⁹ Regrettably, it would appear that peripheral ring sections were excluded from the study. Field examinations were only possible where there were ‘locally flat surfaces’²⁰⁰ and it would appear that these were generally confined to the core regions of the stumps. Yet the very existence of these flat surfaces is suggestive of catastrophic processes at work, since they are deemed to be a consequence of transverse fracturing of the trees at stump level.²⁰¹

Finally, Arct²⁰² noted that frost rings have never been reported from trees in the Yellowstone ‘fossil forests’ — **suggesting that a slightly warmer (and more temperate) climate prevailed at, and for some time before, the trees’ demise.** Such a climate regime could be accommodated within a pre-Flood canopy framework — although the nature of such a canopy is the subject of ongoing debate amongst creationists at the present time. For instance, Wise²⁰³ has recently argued that early unitemperate (and completely enveloping) canopy models — such as those advocated by Whitcomb and Morris²⁰⁴ and Dillow²⁰⁵ — are in need of re-evaluation, given the range of climatic regimes present in Mesozoic and early Cenozoic fossil woods. On the other hand, little research has been carried out into the development of climatic models framed around **partially enveloping canopies.** One such model, devised by Johnson,²⁰⁶ overcomes some, but certainly not all, of the problems inherent in canopy theories.

Alternatively, a model embracing significantly higher concentrations of CO₂ in the past could also be employed to explain the existence of ‘fossil forests’ at latitudes significantly higher than is the case today; the carbon

dioxide creating an artificial ‘greenhouse’ environment.^{207–209}

Purbeck Fossil Forests — Southern England

The Jurassic ‘fossil forests’ of the basal Purbeck Formation are located in the chalk-lands of southern Dorset, at a latitude of approximately 50.5°N. Several exposures are to be found along a 30 kilometre section of the Dorset coast — extending from the Isle of Portland and Dorchester in the west to Swanage in the east.

The vegetation is described by Francis²¹⁰ as being typical of ‘... well-developed gymnosperm forests.’ The predominant tree is the common conifer, *Protocupressinoxylon purbeckensis*. Whilst two other conifers, *Auracarioxylon* and *Circoporoxylon*, are only represented by wood fragments. The rings of the petrified trees were very narrow (the average for all tree samples studied by Francis²¹¹ being 1.13mm) and extremely sensitive — suggesting that the climatic regime under which they lived was one of extreme variance; possibly a Mediterranean-type climate.²¹² The trees are generally poorly preserved and an accurate assessment of age is not possible. Nevertheless, open burrs at the Portland site, ranging in diameter from 70cm up to 114cm, may give some measure of the size and age of the original tree trunks prior to fossilisation.²¹³ A maximum age of the order of 1,000 years is not unrealistic.

Alaskan ‘Fossil Forests’

Research by Parrish and Spicer into the so-called ‘fossil forests’ of the Central North Slope, Alaska, is documented in two separate papers in the journal **Palaeontology**.^{214,215} The fossilised remains of coniferous trees were found throughout two Cretaceous formations along the Colville River valley in northern Alaska at an approximate latitude of 69.5°N. The first and lower (earlier) of the two formations containing the remnants of these forests is the **Nanushuk Group**. The second group of deposits to contain the fossilised remains of trees is the **Kogosukruk Tongue of the Prince Creek Formation**, situated approximately 150 kilometres further to the east and in closer proximity to the Arctic Ocean.

The predominant species of conifer in both formations was *Xenoxylon latiporosum*,^{216,217} which was widespread throughout northern high latitudes during the Cretaceous period.

In the Nanushuk Group most of the fossilised logs **ranged between 25 and 50 centimetres in diameter** and featured wide annular rings.²¹⁸ By way of comparison, the fossil trees from the Kogosukruk Tongue were generally smaller — **rarely exceeding 20 centimetres in trunk diameter** (the largest specimen did, however, attain a diameter of 50cm).²¹⁹ Furthermore, the growth rings were quite narrow, with an abundance of false rings (in stark contrast to the pattern in the Nanushuk trees). The authors have suggested that the climatic regime under which the

trees from the Kogosukruk Tongue lived was somewhat severer than that under which the Nanushuk trees lived.²²⁰

Whilst neither paper attempts to establish the ages of the various trees at the time of their demise, it is plainly apparent from the cited mean ring-widths^{221,222} that we are dealing with relatively young (and possibly immature) forest trees in both instances.

Axel Heiberg and Ellesmere Islands (Arctic Canada)

The ‘fossil forests’ of Axel Heiberg and Ellesmere Islands^{223–225} are located well within the Arctic Circle — at latitude 78.5° N. They are found in sedimentary deposits of Early Tertiary (Palaeocene or Eocene) age. The predominant tree at the three primary sites (the Strand Fiord Basin of Axel Heiberg Island, the Hot Weather Creek site at the Remus Basin and along the banks of the Fossil Forest River and adjacent to the Strathcona Fiord on Ellesmere Island) is the **dawn redwood**, *Metasequoia*.^{226–228} The remains of **swamp cypress**, *Glyptostrobus*, are also present as are leaves and cones of larch, spruce, fir, pine, alder, birch, oak, hickory and katsura.²²⁹

At the Strathcona site there is a predominance of tree stumps. The remains of logs are relatively rare at the same site. Nevertheless, the diameters of the preserved trunks generally fall between 40cm and 60cm.²³⁰ The two largest specimens possessed diameters in excess of one metre.²³¹ It is thought that the Strathcona trees possibly attained heights of between 40 metres and 50 metres.²³²

On the other hand, both stumps *and* logs are present in great abundance at the Hot Weather Creek site.²³³

According to Francis and McMillan²³⁴ the trees: ‘... probably grew to a great age — *perhaps 1000 years old.*’ Francis also notes that the growth rings in these fossil trees were up to 10 millimetres wide, suggestive of a ‘... very favourable warm, wet environment.’²³⁵

Furthermore, on Axel Heiberg we have a depositional sequence similar to the so-called ‘fossil forests’ at Yellowstone National Park. Concerning the Axel Heiberg ‘forests’ Francis and McMillan have noted that they: ‘... are stacked one above the other — (with) more than 20 at one locality. Some of the forests are interbedded with sands and silts deposited in an active fluvial environment.’²³⁶ They then go on to say: ‘The sands contain 8-metre long dawn redwood logs, which were preserved presumably after floods.’²³⁷

Unlike the preserved remains of stumps, logs and foliage at more southerly latitudes, the remains at Axel Heiberg and Ellesmere were often not even permineralised, but **preserved in a barely lignitic and mummified state**.^{238,239} In fact, Francis and McMillan note that: ‘They look fresh but slightly darkened. The trees have retained so much of their original woody tissue that they will burn like fresh firewood.’²⁴⁰ It is very difficult to reconcile the purported age of these trees (45 million years!) with the fact that they exhibit no permineralisation and little decay

or insect predation.

Antarctic ‘Fossil Forests’

The remains of so-called ‘fossil forests’ have been discovered at numerous sites throughout the continent of Antarctica. Perhaps the best known sites are to be found in the general vicinity of the Antarctic Peninsula, including the Fossil Bluff Formation in the south-east corner of Alexander Island; the Byers Peninsula region of Livingstone Island; James Ross, Seymour and Vega Islands, and several sites along the Trinity Peninsula (the northern-most extremity of the Antarctic Peninsula).^{241,242} Collectively, these forests extend between latitudes 62.5°S and 72.5° S.

The ‘forests’ are generally regarded as belonging to the Cretaceous era.^{243,244} Tertiary ‘forests’ are also said to be present in the north-eastern corner of Seymour Island.²⁴⁵

Both angiosperms and gymnosperms were present: the former represented by the southern beech, *Nothofagus*, and the latter by trees of podocarp and araucarian conifer affinity.^{246,247}

According to Jefferson²⁴⁸ the preserved stumps on Alexander Island ranged between 8cm and 22cm in diameter. By way of comparison, the trunks (or branches) of angiosperms, described by Francis, are thought to have been at least 30 to 40cm in diameter.²⁴⁹ The largest logs recovered from Seymour Island, according to Zinsmeister, are said to range **up to one metre in diameter**.²⁵⁰

The mean ring width for the various angiosperm specimens ranged from 1.32mm up to 7.50mm, whilst that for the conifers ranged from 0.52mm up to 5.57mm.²⁵¹ The ages of the petrified trees at the time of interment is unknown. However, given a mean ring width value for the combined Cretaceous/Tertiary sample of 2.30mm and the approximate diameter of the largest logs (up to one metre), it appears highly unlikely that we would find too many trees exceeding 1,000 years in age.

More recently again, Edith Taylor, of Ohio State University, has reported the discovery of fossilised ‘polar forests’ comprising the remains of *Glossopteris* (seed-bearing) fern trees.^{252,253} These Permian ‘forests’ have been discovered on a ridge of Mount Acheron in the Transantarctic Mountains near the Ross Ice Shelf. They (possibly) represent the highest polar ‘forests’ to be discovered to date, **lying within 5 degrees to 10 degrees of the geographical south pole**. However, the stumps of the 15 permineralised trees examined by Taylor and her colleagues ranged between 9cm and 18cm in diameter only,²⁵⁴ quite small in comparison with other slightly lower latitudinal Arctic fossil forests!

Concerning the Alexander Island ‘fossil forests’, Jefferson²⁵⁵ noted a very strong North/South orientation of the long axes of the fossilised stumps, whilst Francis²⁵⁶ has observed that:

‘Some of the trees that grew on the Peninsula were

also carried down rivers as driftwood into the marine back-arc basin The logs were then buried in shallow marine silts and muds and premineralized by carbonate solutions These trees can now be found as large petrified logs weathered from Cretaceous sediments on the islands in the Peninsular region Their orientations are aligned with the main current directions of the rivers that flowed from the land, as shown by palaeocurrent indicators in the sediments.'

Such orientation is consistent with that observed by Coffin²⁵⁷ and Fritz²⁵⁸ at the Yellowstone National Park 'fossil forests'.

Tasmanian Log Jams

The remains of an ancient log jam, thought to be 30 million years old, were discovered in northwest Tasmania in 1986.²⁵⁹ The subfossil logs, twigs and leaves comprising the log jam had been preserved in a layer of silt, exposed in a forestry road cutting south of the Arthur River. The remains represent a bizarre collection of different species of trees, including several species of myrtle, now only found in Chile and New Guinea, ancestral forms of New Zealand kauri pines, and even relatives of the macrocarpa and *Sequoia*. It has been suggested that the forest from which this diverse group of species derived would have resembled the sub-tropical forests of highland New Guinea today.²⁶⁰ In this regard, the mixed assemblages at Arthur River are analogous to those at Yellowstone.

Specimens from after the Flood

The study of fossil and subfossil trees can often reveal the climatology and ecological circumstances under which the trees lived. For instance, the onset and subsequent abatement of a post-Flood Ice Age would have impacted dramatically on plant life across the face of the globe.

For instance, Arct²⁶¹ refers to studies by Munaut (1967)²⁶² of subfossil trees recovered from a peat bog in Terneuzen, Holland. He notes concerning the demise of these trees that:

*'Rings from 56 pines were measured and crossdated, resulting in two floating chronologies, averaged from six trees each of which showed a plausible agreement over a period of 220 years. Evidence pointed to a relatively sudden death from an apparent rise of the water table. Many trees died 100 years before the end of the community as evidenced by crossdating and partial decomposition with insect galleries and worm tracks.'*²⁶³

These trees were subsequently dated by radiocarbon to between 2300 BC and 2500 BC, dates which correspond remarkably well with the timing of the biblical Flood according to the 'tight' Massoretic chronology.

However, the gradual demise of these trees over a period of 100 years and as a consequence of a rising water

table raises the possibility that death occurred during the deglaciation phase of a post-Flood Ice Age.

EXTENDED TREE-RING CHRONOLOGIES: IMPLICATIONS ARISING

Our appraisal of tree-ring dating would not be complete without an examination of the implications arising from the extended bristlecone pine and oak master chronologies. These chronologies currently extend backwards in time some 8,663 years and 9,928 years, respectively. They **already exceed the timeframes allowable for post-Flood earth and human history based on the Massoretic and Septuagint texts of the Old Testament** (between 4,302 years and 5,182 years, respectively).

It could be argued that both the tree-ring master chronologies and 'tight' (or short) biblical chronologies are prone to the same sort of criticism. For instance, the veracity of any tree-ring chronology is contingent upon the identification of both missing and multiple (intra-annual or extra) growth rings. Renfrew²⁶⁴ expressed the problem in the following manner:

'For the first of these steps in the argument, scholars have to rely on the accuracy of the work of Ferguson and his colleagues in Arizona. If they are wrong, so is the entire calibration. Their work, however, is based on the meticulous compilation of data, using many trees, living and dead, with a full awareness of the statistical problem and of the difficulties caused by missing and multiple growth-rings.'

Likewise, the veracity of a tight biblical chronology is contingent upon the completeness of the genealogies comprising that chronology. The great American archaeologist Joseph Free²⁶⁵ explained it this way:

'B. B. Warfield pointed out that there may be gaps in the Biblical genealogies. This is not mere theory, but is given possible support by the fact that certain genealogies omit some of the generations. Such occurrences give evidence that the Bible may not give a complete record in a genealogy, but rather an indication of line of descent.'

To compound the problem even further, there is also the possibility of a transcription error in one of the New Testament genealogies; an error leading to the inclusion of an **extra** post-Flood patriarch.^{266,267}

Are there Gaps in the Genesis Genealogies?

Whilst it may appear somewhat premature and, perhaps, dogmatic to some to preclude the possibility of gaps in the Genesis genealogies, the present author believes that there are a number of arguments from within the Scriptures themselves that either provide support for a tight chronology for Genesis 5 and 11 or, at least, limit the number of opportunities for gaps. They are as follows:

- (1) The description of Seth as a replacement son for Adam and Eve (Genesis 4:25), and the subsequent

- birth of Enosh to Seth (Genesis 4:26).²⁶⁸
- (2) The testimony of Jude 14 to Enoch being '(in) *the seventh (generation) from Adam*.'²⁶⁹
 - (3) The possible significance of the name *Methuselah* — '*When he dies it (the Flood?) will come*' or '*When he dies, judgement*' — would be lost if his death did not immediately precede the Flood, as it does in a tight chronology based on the Massoretic, or Septuagint (LXX), texts of Genesis 5.^{270,271}
 - (4) The firm father/son relationship between Noah and Shem, Ham and Japheth (Genesis 9:18).
 - (5) The emphatic nature of Genesis 10:22 and 11:10 with respect to the father/son relationship between Shem and Arphachshad.²⁷²
 - (6) The emphatic nature of Genesis 10:25 and 1 Chronicles 1:19 with respect to the father/son relationship between Eber and his two sons — Peleg and Joktan.
 - (7) The father/son relationship between Terah and his three sons — Nahor, Haran and Abram (Genesis 11:27) — is reaffirmed in Genesis 11:28 and 31. In Genesis 11:27 Lot is proclaimed to be the son of Haran, whilst Genesis 11:31 describes Lot as the grandson ('son's son') of Terah. We also learn from Genesis 12:5 that Lot is Abram's nephew ('his brother's son'). Furthermore, Genesis 11:28 informs us that Abram's brother, Haran, died before Terah, whilst Genesis 11:26,32 and 12:4 impose added constraints on the possibility of intermediaries. Finally, Milcah (Genesis 11:29) is described as the wife of Abraham's brother, Nahor (Genesis 24:15).
 - (8) The inclusion of the ages of the pre- and post-Flood patriarchs at the time of the birth of their direct descendant (a son, though not necessarily first-born) makes little sense if a chronology is not intended in the first instance. Indeed, it would appear that these ages, **together with the residual number of years between the birth of the lineal descendant and death of the patriarch as well as the patriarch's lifespan**, demand a chronological intent by the compositor (Moses).
 - (9) The replication of the same (identical) Massoretic genealogy elsewhere in the Old Testament Scriptures (1 Chronicles 1:1–4, 17–19, 24–27).
and
 - (10) The context and substance of Luke's genealogical account — the relationship between Jesus and Adam (a theme taken up by Paul in Romans 5:12–21 and 1 Corinthians 15:22, 45–49) — strongly favours a literal father/son relationship and not a vague indication of lineal descent or gaps in the genealogy.²⁷³

Whilst these arguments are by no means sufficient in themselves to rule out the possibility of gaps in the Genesis genealogies, they certainly reduce the probability of such in the case of the pre-Flood patriarchs (since the only remaining area for a potential gap is between Enoch and Methuselah). On the other hand, we can be less

certain regarding the completeness of the post-Flood patriarchal genealogy. For instance, gaps could still exist between Arphachshad and Eber, on the one hand, and Peleg and Terah on the other. The lifespans of the post-Flood patriarchs also hint of the possibility of gaps in the genealogy. For instance, there is a dramatic decline in longevity between Eber and Peleg.²⁷⁴

Whilst recognising that the Hebrew word for 'begat' (*yalad*) can mean both a paternal relationship in the immediate sense (for example, 'became the father of') or in the broader sense (for example, father to a line of descendants ending in a particular person), it is imperative that we do not lose sight of the fact that, even allowing for the possibility of gaps in the post-Flood patriarchal genealogy, it is doubtful whether such gaps could account for a 'stretching' of post-diluvial history to the extent demanded by the current oak and bristlecone pine chronologies.

On the other hand, the apparent legitimacy of the tree-ring chronologies is not to be taken lightly. It has already led at least one recent creationist (Aardsma²⁷⁵) to consider the possibility that the biblical Flood occurred at a point in time beyond the current limits of the oak and bristlecone pine chronologies.

The confidence expressed in the accuracy of bristlecone pine chronologies is, at times, breath-taking. For instance, Bryant Bannister, a former Director of the University of Arizona's Laboratory of Tree-Ring Research, is quoted as saying: '*It's the total assurance that when you say the year is 1221, you mean 1221 and not 1220 or 1222.*'²⁷⁶ However, he then goes on to add: '*It sounds simple, but isn't. The key is the dating control. If you don't have that, no matter how sophisticated the analysis, it's pure garbage.*'²⁷⁷ So just how secure are the long chronologies?

The Dating Controls for Tree-Ring Chronologies

The dendrochronologist is confronted with many difficulties when attempting to extend an existing chronology.²⁷⁸ Whilst it may seem a relatively easy, though admittedly tedious, task to secure visual cross-matches between the cores of various specimens from a particular region or locality and timeframe, it seldom proves simple in reality.

The basic premise behind any master chronology is that the individual elements comprising the chronology faithfully reflect the year-to-year variation in climate for the particular region **and that these variations are never quite the same.**²⁷⁹ Whilst long-term patterns (say, 100-plus years) are seldom, if ever, replicated in even the longest chronologies, it is possible to find recurrent short-term patterns in the same chronologies. For instance, recent analyses of a number of chronologies from America's southwest have revealed **recurrent short-term climatic patterns or cycles**. These cycles, each 22 years

long, have been linked to recurrent droughts and are thought to **coincide with alternative periods of minimum sunspot activity**.²⁸⁰ The same periodicity has also been detected in the fluctuating levels of deuterium observed in a single bristlecone pine dating back to the year AD 970.²⁸¹ The strength of a particular chronology is, therefore, dependent upon the identification of long-term patterns of ring-width variation in a number of individual specimens and a reasonable degree of overlap between the constituent elements of the chronology.

The identification of long-term patterns is rendered all the more difficult when the specimens from a particular region exhibit extreme degrees of sensitivity and/or complacency. The strong correlation between mean sensitivity, ring width and the incidence of missing rings has already been highlighted. The dilemma confronting the dendrochronologist is that, for many tree species, **correlation with climate and cross-matching between trees is at its best when ring-width is relatively narrow and the incidence of missing rings is becoming significant**.²⁸²

Whilst the problem of missing rings may appear a serious one at first, in many species at least half of the missing rings may be found with supplementary coring near the original core.²⁸³ (In the bristlecone pine the combination of extremely slow growth rates and climatic stress renders it decidedly more difficult to locate a vestige of a missing ring.²⁸⁴) When this practice fails, it becomes necessary to draw upon comparisons with other, less sensitive (more complacent) specimens.²⁸⁵

When we examine the White Mountains master chronology there is a surprisingly high dependence upon complacent specimens throughout much of the existing long chronology. For instance, the two specimens linking the Schulman master with the remainder of the extended chronology (TRL 63–88 and TRL 63–43) **are both assessed as being complacent**.²⁸⁶ There is also a high proportion of complacent specimens between 2401 BC and 2900 BC. A single sensitive specimen (TRL 64–F22) is cross-matched with two to three acknowledged complacent specimens (TRL 63–89, TRL 66–405 and TRL 65–F131) over this segment of the chronology.²⁸⁷

The inclusion of both sensitive and complacent specimens in the same chronology is not as disconcerting as one might be led to believe, since even *generally* complacent cores contain at least a few rings noticeably smaller than the running average. These, in turn, may allow cross-matching to take place.²⁸⁸ (Of course, the primary reason for including generally complacent specimens in such a chronology is that they are less likely to suffer from missing rings.)

For several decades now dendrochronologists have sought after ways and means of speeding-up the cross-dating process. One such method, which has virtually become a standard practice, involves the radiocarbon dating of specimens of hitherto unknown age and relation-

ship to an established chronology. This procedure allows the dendrochronologist to establish an approximate relationship between a 'floating' specimen and other components of an established chronology.²⁸⁹ Ferguson *et al.* refer to such assessments of age as 'quickie' dates.²⁹⁰ The same practice, however, presupposes the veracity of the generally accepted steady-state model for radiocarbon dating (as devised by Libby).

Having examined the theoretical bases of the extended bristlecone pine and western European oak chronologies, Aardsma²⁹¹ concluded that:

'One could suppose that, whereas the annual nature of the rings might be granted, the overall tree-ring chronology is still too long because of gross errors in its construction. But since these chronologies are constructed from numerous overlapping continuous tree-ring cores, such a problem is clearly not likely.'

He then reinforces this view by stating that:

*'Whilst it is possible to imagine a researcher artificially extending a given tree-ring series accidentally ... Radiocarbon provides a check on such errors because the specific activity of radiocarbon versus time characteristic of the tree-ring data must be continuous.'*²⁹²

Nevertheless, the White Mountains bristlecone pine chronology may still suffer from a number of potentially serious problems.

As the name implies, the White Mountains are composed of dolomite (or dolomitic limestone). The substrata on which the bristlecone pines grow is also dolomitic limestone.²⁹³ The soil profile²⁹⁴ is, therefore, likely to give rise to hard (calcium and magnesium carbonate-rich) groundwaters and these, in turn, will be absorbed by the pines throughout (and perhaps even after) their lifespan is complete. Because the carbonates derive from what are, almost certainly, Flood deposits, they are unlikely to contain significant amounts of radiocarbon.^{295,296} It follows that the pines' timber might, therefore, contain higher than normal concentrations of natural carbon and this, in turn, will distort the ratios of ¹⁴C to stable carbon and result in **inflated radiocarbon ages for the cores comprising the chronology**.^{297–299}

The extended bristlecone pine chronologies will, under such circumstances, preserve the 'apparent' relationship between radiocarbon and tree-ring ages throughout the entire length of the chronology. However, they will not reflect 'real-time' in the sense of each ring representing a single year's growth. Rather, they will reflect **a significantly higher incidence of multiple (or intra-annular) rings in the past**.

But how realistic is the notion of vast numbers of intra-annular rings in the past? Indeed, is it possible to distinguish between intra-annular and normal annual growth rings?

In 1963 Glock and Agerter³⁰⁰ presented the findings of a study into trees known to produce **many** intra-annular

rings in a single growing season. They concluded that the intra-annular rings were **as distinctly formed as true annual rings**. More recently, Lammerts³⁰¹ has shown that drought-induced intra-annular rings in bristlecone pine seedlings are virtually indistinguishable from those of annular growth rings.

Whilst LaMarche and Harlan³⁰² have presented a number of arguments in support of the notion that each bristlecone pine ring represents an annual increment of growth, such examinations are restricted to an 18-year period (1954–1971) only.³⁰³ This observation period is the equivalent of 0.2 percent of the total length of the existing White Mountains master chronology. Given the possibility of vastly different climatic regimes between the Flood and the conclusion of the Ice Age³⁰⁴ and that the White Mountains region was significantly wetter even in the recent past,³⁰⁵ can we be certain that the bristlecone pines didn't produce intra-annular rings on an occasional, if not regular, basis in the past? (The uniformitarian principle is implicit in the extrapolations of LaMarche and Harlan.)

LaMarche and Harlan have suggested that discrimination between annular and intra-annular rings is possible on the basis of the boundary condition between succeeding rings. They have argued that:

*"The growth rings of bristlecone pine do not resemble the "false" rings found in some other species of trees. Such intraannual growth bands, which could be misidentified and counted as annual rings, are generally seen to have diffuse or gradational boundaries upon close inspection under the microscope."*³⁰⁶

However, Glock and Agerter have pointed out that latewoods (broadly speaking) '*... do not always end in sharp boundaries. Gradations may vary from sharp to diffuse.*'³⁰⁷ Furthermore, even LaMarche and Harlan have conceded that, whilst the boundaries in bristlecone pines are '*... almost invariably sharp ...*', there are exceptions to the rule;³⁰⁸ although they hasten to add that specimens containing such rings '*... are normally discarded for dating purposes and do not represent an important source of uncertainty in tree ring dates.*'³⁰⁹

Nevertheless, evidence for the presence of intra-annular rings may already have been garnered from attempts to 'fit' Pine Alpha to the White Mountains filtered master chronology. For instance, whilst an excellent cross-match exists between Pine Alpha and the filtered White Mountains master chronology between the years 2030 BC and 1831 BC³¹⁰, '*... The total tree-ring record for Pine Alpha ... has not yet been worked out because of a compressed interval between 1700 BC and 1200 BC.*'³¹¹ Could such compression reflect a period of mis-match and, therefore, a disparity in the ring counts over this period?

Similarly, in the western European composite oak and Scots pine chronologies there are a number of 'plateaux' in the ¹⁴C ages, each of which may infer an extended

period of interposed intra-annular ring growth.³¹²

Given that such plateaux and other short-term fluctuations are commonplace along much of the length of most ¹⁴C age/dendro-year calibration charts^{313,314} — **especially in the period preceding the common era** — can we assume that bristlecone pine, and oak and Scots pine chronologies, as presently constructed, are devoid of intra-annular rings? And is there any significance in the fact that the present limit in the giant sequoia chronology coincides with the termination of the compressed interval in Pine Alpha?

Transitional Models for a Stabilising Radiocarbon Inventory

We have already referred to the work of Aardsma in relation to the dating of the Flood. Accepting the extended bristlecone pine and oak chronologies at face value, Aardsma has developed a rigorous transitional (non steady-state) model for radiocarbon dating.³¹⁵ The model sets a most probable date for the Flood at 14,000 years BP and a post-Flood Ice Age several thousand years beyond the limits of the existing long bristlecone pine and oak chronologies.³¹⁶ Aardsma's model accords well with the latest observations concerning the timing of the Late Glacial/Holocene boundary.³¹⁷ Moreover, in a more recent paper, Aardsma³¹⁸ has shown that some of the short-term deviations in radiocarbon age correspond with periods of relative solar quiescence and that the constancy of the width of these periods argues against the proposition of there being significant numbers of intra-annular rings in the remote past. Nevertheless, Aardsma's model also imposes an inordinate 'stretching' of the post-Flood genealogy as outlined in Genesis 11; of the order of a 28-fold increase on the 'tight' Massoretic chronology for the interval between the Flood and the birth of Abram. (Even the Septuagint would involve a 9-fold stretching for the same interval.)

Putting aside for the moment the possibility that the extended oak and bristlecone pine chronologies may be valid and that there may be significant gaps in the post-Flood genealogy, it is possible to derive alternative transitional models which are capable of correlating radiocarbon ages and 'real-time' within a 'tight' historical framework. One such model has been described recently by Brown.³¹⁹ Of course, such a model would demand the compression of the long tree-ring chronologies and vast numbers of inter-annular rings in the remote past.

A Dilemma Confronting Creationists

Whilst there is a mounting body of evidence pointing to a global ceiling in the longevity of the earth's oldest living trees, the evidence for continuous tree-ring chronologies of lengths exceeding that for a post-Flood epoch based on either the Massoretic and Septuagint texts of Genesis 11 is not to be taken lightly.

The dilemma confronting creationists is well summa-

rised by Aardsma.³²⁰ He asks:

*‘... the implied gap or gaps in this (Genesis 11) genealogy are **surprisingly large**. Furthermore, one is left with two looming questions. First, where exactly do these gaps fall in this genealogy. Secondly, **what is the significance of the numerical information given in Genesis 11 if it is not to be used for direct chronological reckoning?**’*

Is it possible to resolve this dilemma? The present writer believes that it may be so, in time. The recent discovery of a large number of subfossil Huon pine logs along the banks of the Stanley River, some 30 kilometres northwest of Mount Reid (Tasmania), offers some prospects of testing Aardsma’s hypothetical timeframes for the Flood and Ice Age. In a recent television interview Dr Mike Barbetti of the University of Sydney stated that these logs cover a broad range of ages, with good coverage back as far as 15,000 years BP.³²¹ Barbetti believes that it may be possible to construct a continuous tree-ring chronology 15,000 years or more from these logs. Furthermore, one such ‘floater’ has been dated by radiocarbon at 38,000 years BP, and Barbetti and his colleagues are suggesting that this particular specimen may be as old as 125,000 yr BP.

It remains to be seen whether a continuous chronology can be developed from these Huon pines. Nevertheless, the earliest specimens dated thus far are significantly older than the earliest oak and bristlecone pine ‘floaters’ and, based on Aardsma’s transitional model, would fall within the period between the Flood and the end of the Ice Age.³²²

SOME TENTATIVE CONCLUSIONS

Ancient, but still living, as well as petrified trees can tell us much about past earth history. Whilst recognising that the duration of the post-Flood epoch is somewhat less secure than that of the pre-Flood epoch, it may be possible to draw some very tentative conclusions from the observations made thus far.

First, the apparent ‘ceiling’ in the ages of the oldest living trees on earth — the bristlecone pines and Sierra redwoods from the southwestern United States — *may* point to a local, if not global, catastrophe some time in the recent past; perhaps as recently as four to five thousand years ago. On the other hand, if the extended oak and bristlecone pine chronologies do reflect real-time, the ceiling will merely reflect the longevity potential of the various species of long-lived trees and creationists will need to contemplate an earlier date for the Flood.

Secondly, the retarded early growth of the oldest living bristlecone pines *may* point to a time of great climatic stress shortly after this cataclysm, a period perhaps corresponding with a short, but intense, post-Flood Ice Age. (If not, the retarded growth merely reflects the hostile micro-site conditions under which the pines have

and continue to grow.)

Thirdly, the debarked and petrified or permineralised remains of fossil sequoias, pines, oaks, etc. could well represent antediluvian flora buried towards the end, or some time after, the Flood year. The bark and leaf material from vast ‘floating mats’ and log jams would have provided the very raw materials for the formation of coal, oil and natural gas deposits.

Fourthly, the absence of fossilised remains of animals in the deposits containing the so-called ‘fossil forests’ at Specimen Ridge (Yellowstone National Park) suggests that they had been wiped out some time before the interment of the tree trunks.

Fifthly, tree ring studies by Arct³²³ (and, more recently, Ammons *et al.*³²⁴) have raised the possibility that segments, if not the whole sequence, of the Specimen Ridge ‘fossil forests’ were deposited during a relatively brief period of time; with at least three successive ‘living floors’ at the base of the formation containing distinctive ‘signature’ patterns suggestive of contemporaneity. The same may well hold for the ‘fossil forests’ at the Florissant Fossil Beds National Monument; see Gregory.³²⁵

Sixthly, the distribution of Mesozoic and early Tertiary fossil forests *may* imply that a broader band of temperate climatic zones existed in the past — zones which extended into the high latitudes of both hemispheres. Nevertheless, there appears to be a dramatic drop-off in the growth potential of such forests between latitudes 70° and 85°.

Finally, the petrified or subfossil remains of giant, coastal and dawn redwoods are, without exception, relatively young when compared with their oldest living descendants in today’s world. The living sequoias’ apparent resistance to decay, insect predation and ageing (senescence) is either not reflected in these ancestral forms or the ancestral forms invariably met with an untimely demise prior to attaining ‘old age’. The latter possibility would seem to accord well with a global Flood and a relatively short antediluvian epoch.

In 1958 Schulman suggested that the state of California appeared to have a monopoly when it came to trees of great longevity.³²⁶ No longer does this appear to be the case. Recent tree-ring surveys outside the United States have identified a number of long-lived tree species — **several of which are now known to exceed 2,000 years**. These include the European yew and Tasmanian Huon pine. It also remains possible that individual specimens of the South American *Fitzroya*, the New Zealand kauri and the negrohead beech and brush box trees of eastern Australia may live to ages well in excess of 2,000 years.

The decimation of native forests the world over — especially during the expansionist periods of the late 19th and early 20th centuries and prior to the establishment of National Parks and wilderness areas — may well have robbed dendrochronologists of many long-lived trees with ages comparable with those of the oldest bristlecone

pinus and giant sequoias. The possible existence of trees of equally great longevity the world over provides a measure of support for the notion of a global catastrophe in the past.

Nevertheless, whilst there is a growing body of circumstantial evidence for a global catastrophe within the past four to five thousand years, there still remains the issue of the apparent legitimacy of the extended bristlecone pine and oak chronologies and the related issue of whether or not there are substantial gaps in the genealogies of Genesis 5 and 11. These issues may, ultimately, be resolved with a systematic review of the extended chronologies in the light of recurrent cycles of ring-growth and a more accurate assessment of the radiocarbon (¹⁴C) and stable carbon (¹²C and ¹³C) inventories immediately following the biblical Flood.

In conclusion, whilst the apparent ceilings (or 'upper limits') in the ages of both Mesozoic and early Cenozoic fossil trees and still-living patriarchs do not, of themselves, establish beyond doubt the veracity of 'tight' Bible-based chronologies of human (and earth) history, they do appear to provide a measure of *prima facie* and *circumstantial* evidence in favour of the timeframes for both the pre- and post-Flood epochs based on the Massoretic text of the Hebrew Scriptures.

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and this has led some observers to believe that the big trees may have weathered the glacial advances and their attendant low temperatures in approximately their present locations.'

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Metasequoias are readily distinguishable from their living cousins, the coast and giant redwoods. First, they are smaller in stature — mature dawn redwoods only attain a height of just under 30 metres (100 feet), although their basal diameters average about 1.8 metres (or 6 feet). Secondly, they are deciduous, in contrast to the coast and giant redwoods, which are evergreens.
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Francis contends that the so-called *in situ* 'fossil forests' grew on sites adjacent to a shallow and hypersaline lagoon. However, she has also noted that:
'In most of the empty central holes of the "doughnut-shaped" domes or "burrs", small fragments of silicified wood still remain and often the impression of the wood grain is present on the inside walls' (p. 289).
This would seem to infer the removal of tree bark *prior* to burial and fossilisation, and the possibility that allochthonous processes were behind the formation of the so-called 'forests'.
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 216. Parrish and Spicer, Ref. 214, p. 19.
 217. Spicer and Parrish, Ref. 215, p. 225.
 218. Parrish and Spicer, Ref. 214, p. 24.
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 222. Spicer and Parrish, Ref. 215, p. 234.
 223. Francis, J. E. and McMillan, N. J., 1987. Fossil forests in the Far North. **Geos**, 16(1):6–9.
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 225. Francis, J. E., 1990. Polar fossil forests. **Geology Today**, 6(3):92–95.
 226. Francis and McMillan, Ref. 223, p. 8.
 227. Francis, Ref. 224, p. 317.
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 229. Francis, Ref. 225, p. 93.
 230. Francis, Ref. 224, p. 316.
 231. Francis, Ref. 224, p. 316.
 232. Francis, Ref. 224, p. 317.
 233. Francis and McMillan, Ref. 223, p. 7.
 234. Francis and McMillan, Ref. 223, p. 8.
 235. Francis, Ref. 225, p. 93.
 236. Francis and McMillan, Ref. 223, p. 8.
 237. Francis and McMillan, Ref. 223, p. 8.
 238. Francis and McMillan, Ref. 223, p. 8.
 239. Francis, Ref. 225, p. 93.
 240. Francis and McMillan, Ref. 223, p. 8.
 241. Jefferson, T. H., 1982. Fossil forests from the Lower Cretaceous of Alexander Island, Antarctica. **Palaeontology**, 25(4):681–708.
 242. Francis, Ref. 86, pp. 665–684.
 243. Jefferson, Ref. 241, p. 681.
 244. Francis, Ref. 86, pp. 665, 666.
 245. Francis, Ref. 86, p. 666 (Figure 1).
 246. Francis, Ref. 86, p. 665 (Abstract).
 247. Francis, Ref. 225, p. 95.
 248. Jefferson, Ref. 241, p. 687.
 249. Francis, Ref. 86, p. 687.
 250. Zinsmeister, W. J., 1987. Review of the Upper Cretaceous-Early Tertiary sequence of Seymour Island, Antarctica. **Journal of the Geological Society of London**, 139:779–785.
 251. Francis, Ref. 56, pp. 671 (Table 2a), 672 (Table 2b).
 252. Taylor, E. L., Taylor, T. N. and Cuneo, N.R., 1992. The present is not the key to the past: a polar forest from the Permian of Antarctica. **Science**, 257:1675–1677.
 253. *Anonymous*, 1992. Polar forest. **New Scientist**, 136(1842):17.
 254. Taylor *et al.*, Ref. 252, p. 1676.
 255. Jefferson, Ref. 241, p. 687.
 256. Francis, Ref. 225, pp. 94, 95.
 257. Coffin, H. G., 1976. Orientation of trees in the Yellowstone petrified forests. **Journal of Paleontology**, 50(3):539–543.
 258. Fritz, Ref. 173, p. 312.
 259. *Anonymous*, 1986. Prehistoric forest near Arthur River. **The Advocate** (Burnie, Tasmania), dated September 18, 1986.
 260. Ref. 259.
 261. Arct, Ref. 20, p. 28.
 262. Munaut, A. V., 1967. Etude Paléo-écologique d'un gisement tourbeux situé à Terneuzen (Pays-Bas). *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek*.
 263. Arct, Ref. 20, p. 28.
 264. Renfrew, Ref. 14, p. 88.
 265. Free, J. P., 1950. **Archaeology and Bible History** (1969 Revised Edition), Scripture Press Publications, Inc., Wheaton, Illinois, p. 17.
 266. Genesis 10:24, 11:12; 1 Chronicles 1:24 cf. Luke 3:35,36.
 267. Morris, H. M., 1976. **The Genesis Record**, Baker Book House, Grand Rapids, Michigan, pp. 281, 282.
Morris points out, correctly, that the name of the extra patriarch — Cainan — appears in some, but by no means all, copies of the Septuagint (the Greek version of the Old Testament). It is possible that Luke, or a subsequent scribe (or copyist of Luke's gospel), used just such a text as source for his own genealogy or copy of the gospel.

- Morris also points out that the name, Cainan, also appears earlier in the same genealogy — as a son of Enosh and father to Mahalaleel; see Luke 3:37, 38.
- It is also significant that, whilst some copies of the LXX include the second Cainan, there is mention (only) of a single, pre-Flood patriarch by that name (Hebrew equivalent of Cainan = Kenan) in the Massoretic, Samaritan and Latin Vulgate versions of Genesis 5.
268. Note the statements ‘... and she (Eve) gave birth to a son, and named him Seth ...’ (verse 25) and to Seth, to him also a son was born; and he called his name Enosh’ (verse 26).
269. Whilst it is conceded that the source of Jude’s quotation is clearly the controversial *pseudepigraphic* Book of Enoch, this is no basis for rejecting the imputed genealogical relationship inferred in the text. The ‘Enoch’ in question is clearly the son of Jared and not the son of Cain (Genesis 4:17).
270. Niessen, R., 1982. A biblical approach to dating the earth: a case for the use of Genesis 5 and 11 as an exact chronology. **Creation Research Society Quarterly**, 19(1):65.
271. Morris, Ref. 267, pp. 155, 159–160.
272. The verse states emphatically that Arphachshad was born two years after the Flood; there is no opportunity here for any intervening generations (that is, intermediate genealogical descendants between Noah and his three sons) since the only people to survive the Flood were Noah, his wife and immediate family; see Genesis 7:23, 8:16, 9:18,19; 1 Peter 3:20 and 2 Peter 2:5.
273. The Greek word for son, *huios*, is usually translated ‘son’ or ‘(male) child’ and therefore infers a definite father/son relationship.
274. Whitcomb and Morris, Ref. 170, p. 482.
275. Aardsma, G. E., 1991. **Radiocarbon and the Genesis Flood**, ICR Technical Monograph, Institute for Creation Research, San Diego, pp. 36–42, 49–50.
276. *Anonymous*, 1977. Tales the tree rings tell. *Mosaic*, Sept/Oct 1977, p. 4.
277. Ref. 276, p. 4.
278. Ferguson, Ref. 41, p. 7.
- Ferguson notes that:
‘Beyond the age limit of each of these controls, however, crossdating among bristlecone pine themselves becomes increasingly important. As the number of trees decreases with each successively older age class, therefore, the location and dating of remnants, especially those with more open ring records, becomes of greater concern.’ (p. 7)
279. Ferguson, Ref. 6, p. 189.
280. *Anonymous*, Ref. 276, p. 7.
281. *Anonymous*, Ref. 276, p. 9.
- A similar periodicity was also observed in a 130-year-old Scots pine by California Institute of Technology geochemists, Samuel Epstein and Crayton J. Yapp.
282. Ferguson, C. W., 1966. Growth-rings of trees: their correlation with climate. *Science*, 154:974 (Figure 1).
283. Ferguson, Ref. 41, p. 6.
284. Ferguson, Ref. 41, p. 7.
285. Ferguson, Ref. 41, p. 7.
286. Ferguson, Ref. 41, pp. 11 (Figure 3) and 12 (Table 2).
287. Ferguson, Ref. 41, pp. 11 (Figure 3) and 12 (Table 2).
288. Ferguson, Ref. 6, p. 195 (Figure 8).
289. Ferguson, Ref. 34, p. 845.
- Ferguson states:
‘Occasionally, a sample from a specimen not yet dated by tree-rings is submitted for radiocarbon analysis. The date obtained indicates the general age of the sample; this gives a clue as to what portion of the master chronology should be scanned, and thus the tree-ring date may be identified more readily.’
290. Ferguson *et al.*, Ref. 63, p. 416.
291. Aardsma, Ref. 275, p. 39.
292. Aardsma, Ref. 275, p. 39.
293. Ferguson, Ref. 34, pp. 841 (Figure 3) and 845.
294. Ferguson, Ref. 41, p. 4.
- Ferguson describes the trees as living in a predominantly dolomitic soil.
295. Brown, R. H., 1992. Correlation of C-14 age with real time. **Creation Research Society Quarterly**, 29(1):46.
296. Aardsma, Ref. 275, pp. 44, 45.
- Later, Aardsma draws attention to the fact that the specific activity of radiocarbon was likely to have been diluted during the pre-Flood epoch because of a much larger quantity of stable carbon atoms in the active pre-Flood reservoirs (p. 46).
297. Wigley, T. M. L., 1976. Effect of mineral precipitation on isotopic composition and ¹⁴C dating of groundwater. **Nature**, 263:219–221.
298. Slattery, D., 1977. Letter to the Editor. **Creation Research Society Quarterly**, 14(3):179.
- Slattery points out that:
‘It is well known that the presence of carbonates in hard water can cause great errors in the results from carbon 14. Often, these errors are in the direction of too great indicated ages’. He then refers to studies of Shotton (Ref. 299 below), which deal with anomalous ¹⁴C datings from Nørre Lyngby, Denmark.
299. Shotton, F. W., 1972. An example of hard-water error in radiocarbon dating of vegetable matter. *Nature*, 240:460–461.
300. Glock, W. S. and Agerter, S., 1963. Anomalous patterns in tree rings. *Endeavour*, XXII(85):11 (Figures 4 to 9), 13.
- With respect to the conifer *Cupressus arizonica*, Glock and Agerter stated that:
‘Three growth layers, in fact, were not unusual. A maximum number of five growth layers was discovered in the trunks and branches of two trees these intra-annual rings were as distinctly developed and as sharply defined on their outer margin as any single annual increment.’ (p. 13)
301. Lammerts, Ref. 47, p. 112 (Figure 6).
302. LaMarche, V. C., Jr. and Harlan, T. P., 1973. Accuracy of tree ring dating of bristlecone pine for calibration of the radiocarbon lime scale. **Journal of Geophysical Research**, 78(36):8849–8854.
303. LaMarche and Harlan, Ref. 302, pp. 8850, 8851.
304. Vardiman, L., 1993. **Ice Cores and the Age of the Earth**, ICR Technical Monograph, Institute for Creation Research, San Diego, pp. 6–7, 51–62.
305. Lammerts, Ref. 47, pp. 113–115.
306. LaMarche and Harlan, Ref. 302, p. 8850.
307. Glock and Agerter, Ref. 300, p. 9.
308. LaMarche and Harlan, Ref. 302, p. 8850.
309. LaMarche and Harlan, Ref. 302, p. 8850.
310. Ferguson, Ref. 41, p. 13 (Figure 4).
311. Ferguson, Ref. 41, p. 13.
312. Becker *et al.*, Ref. 77, p. 648.
- Becker and his colleagues note that:
‘In the early Holocene the long-term ¹⁴C trend is superimposed by strong century-type variations. This leads to intervals of apparent constant ¹⁴C ages for periods of up to 450 dendro-years in the calibration curve. These ¹⁴C plateaux at 10,000, 9,600, 8,750 and 8,200 ¹⁴C yr BP cause severe problems in ¹⁴C dating for the 10,000 to 9,000 ¹⁴C yr BP interval. For example, the 400 ¹⁴C yr interval framed by the two plateaux at 10,000 and 9,600 ¹⁴C yr BP can represent a minimum of 90 and a maximum of 860 years.’ (p. 648)
313. Renfrew, Ref. 14, pp. 292–293 (Figure 58).
314. Becker *et al.*, Ref. 77, p. 648 (Figure 1).
315. Aardsma, Ref. 275, pp. 51–67.
316. Aardsma, Ref. 275, pp. 41, 49.
317. Becker *et al.*, Ref. 77, pp. 647–649.
- Becker and his colleagues conclude that the Late Glacial must have ended at a minimum age of 10,970 dendro-years BP (p. 649).
318. Aardsma, G. E., 1993. Tree-ring dating and multiple ring growth per year. **Creation Research Society Quarterly**, 29(4):184–189.
- Whilst Aardsma has successfully demonstrated a measure of constancy in the duration of the Maunder and Sporer minimums for the entire length of the oak and bristlecone pine chronologies, there are still lengthy intervals between these periods of relatively low solar output (and consequently greater flux of cosmic rays) in which intra-annual rings may have been common place. Aardsma’s argument would be far more convincing if he were to demonstrate the regular

- occurrence of the short-term, 22-year-long drought cycle over the entire length of the existing chronologies.
319. Brown, Ref. 295, pp. 45–47.
Brown's model involved the derivation of an equation for the expression of radiocarbon ages as a function of real-time. He selected an arbitrary value of 5,350 years for the interval between the Flood and the present day, a value more in keeping with a Septuagint-version of post-Flood history. However, the same equation can be readily adjusted to reflect alternative dates for the Flood and biospheric levels of ^{14}C at the time of the Flood.
320. Aardsma, Ref. 318, p. 188.
321. Barbetti, M., 1993. Australian Broadcasting Corporation Channel 2 science show 'Quantum', April 28, 1993.
322. Aardsma, Ref. 275, p. 66 (Figure 5.4).
A Huon pine dated by radiocarbon at 15,000 yr BP would, according to Aardsma's model, have a real-time age of 12,000 years BP. This would place it within the postulated timeframe of a post-Flood Ice Age. As such, we would anticipate a significant reduction in ring-width in line with a decidedly colder climatic regime.
The specimen dating at 38,000 yr BP is of particular interest. The ^{14}C date would seem to infer that the specimen grew very shortly after the Flood. However, the specimen is mature.
323. Arct, Ref. 20, 65 pp.
324. Ammons *et al.*, Ref. 156, pp. 97–108.
325. Gregory, Ref. 152, 246 pp.
326. Schulman, Ref. 15, p. 368.
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