

The Ginkgo Tree: is it a 'living fossil'?

Craig Robertson, May, 2016

Abstract: Legend has it that the Ginkgo or Maidenhair Tree, *Ginkgo biloba*, was thought in the West to be extinct until it was found growing in the East. This paper investigates the discovery of the ginkgo in both its living and fossil forms and shows the legend is incorrect. The plant appears to have been completely unknown in the West, and to science, prior to the arrival of living plants from Japan in the early eighteenth century. Further, the discovery of fossil ginkgos only came by a protracted scientific process long after it was growing in European gardens.



Fig. 1. Melbourne University Earth Sciences History Group lead by Assoc-Prof. Bernie Joyce outside the Old Geology Building in 2007. The male ginkgo overhangs on the left and the female is on the right.

Introduction

The legend of ginkgo as a rediscovered extinct species can be found stated in various sources to the present day (Chandler, 2001; Kwant, 2015).

I first heard the legend of the ginkgo as a living fossil when I was a geology student at Melbourne University in the early 1960s. There were two ginkgos, a male and a female tree, growing on either side of the entrance to the then Geology Department. The remaining (female) tree is now on the City of Melbourne Exceptional Tree Register.

The building is now called the Old Geology Building (**Fig. 1.**) and houses the Science Faculty Office.

The trees were planted from seed in the 1930s by a former Professor of Geology, F.A. Singleton (Patrick Singleton, pers.comm. per Ian Duddy, 2015), because of their fossil history. A former Professor of Botany, Carrick Chambers, remarked on his achievement to have the male and female planted within pollinating distance (Joyce et al, 2003). In more recent times half a dozen additional ginkgos of both sexes have been planted on the small plots of lawn in front of the building; the original male tree died in 2012 and has been replaced by a ginkgo sapling. A member of the staff had imparted the legend to the students.

Discovery of the Living Ginkgo

The ginkgo is recorded in Chinese literature of the Sung Dynasty in the eleventh century, and some earlier visual art (Kwant, 2015), and an even earlier herbal medicinal text (Del Tredici, 1991: 10). Other medicinal texts date from the late Middle Ages when Westerners had begun travelling to the East, making it possible some in the West may have heard of it. However this would only undermine any idea that it had once existed and then become extinct. It is possible the plant itself was known to some Europeans as early as the sixteenth century - the Portuguese were visiting Japan and other parts of the East - but they seem to have left no known record of its observation. In particular there were Jesuit priests in China. One of these, Mateo Ricci, lived and travelled widely in China from 1582 until his death in Beijing in 1610 (Ricci & Trigault, 1615). It is hard to believe he would not have seen ginkgos, but his published works, which are not insignificant and do document a certain amount of Chinese botany and medicine, contain no indication he was aware of the tree.

The first known contact by Europeans with the ginkgo is well-documented. Engelbert Kaempfer was a German-born physician and botanist working for the Dutch East India Company. In 1690 he was posted to Nagasaki in Japan where the company had a trading post. During this period Europeans were generally confined to an artificial island in Nagasaki harbour called Deshima, a structure designed in the distinctive shape of the ginkgo leaf (Crane, 2013: 197). Kaempfer was able to move around to some extent and note that the tree was held in high regard by the Japanese and observe it to be widely grown.

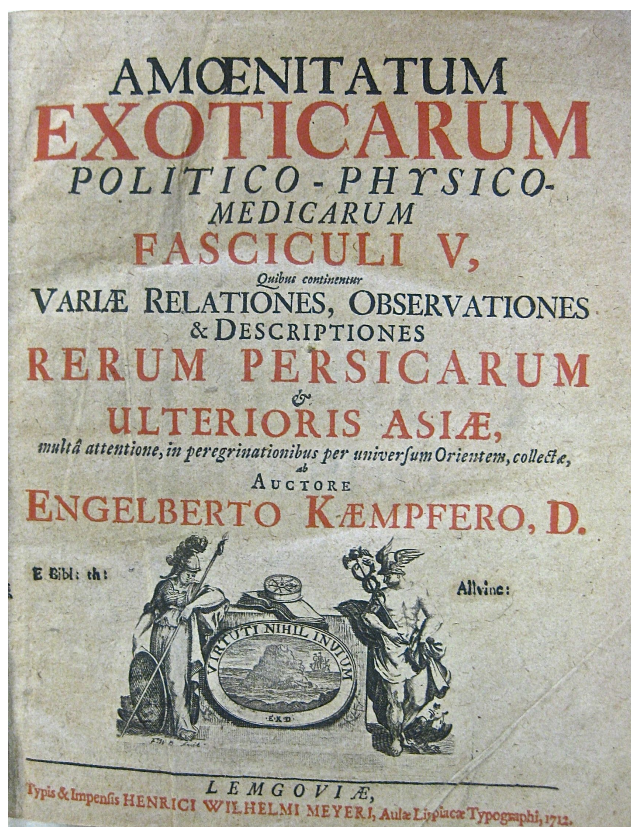
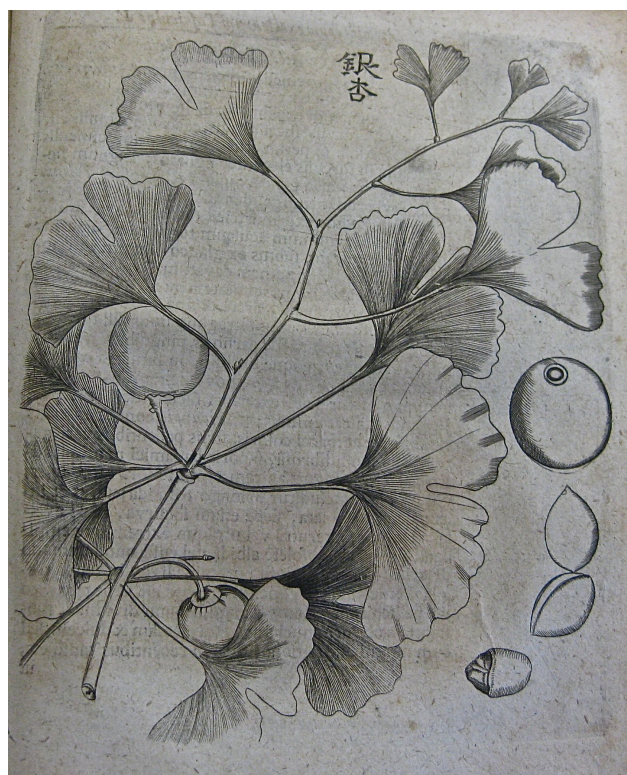


Fig. 2.1. The title page of Engelbert Kaempfer's book in which he introduces the ginkgo to the West with the text **Fig. 2.2** (page 811) and illustration **Fig. 2.3** (page 813).



杏銀 Ginkgo, vel Gin an, vulgò Itjò. Arbor nucifera folio Adiantino.

[Reproduced courtesy of the Baillieu Library Special Collections, Melbourne University.]

Kaempfer not only discovered the tree; he published a description with line drawings (**Fig. 2.3**) of foliage, fruit and seeds in his major work *Amoenitatum exoticarum* (**Fig. 2.1**) in 1712, translated into English in 1723 [1]. It is this account that gives us the name. He stated it to be 'Ginkgo', the word derived from the Japanese 'gin an' (**Fig. 2.2**). There has been considerable discussion over how the latter became transformed into 'ginkgo'. Speculation has focused on Kaempfer's probable misreading of his own early eighteenth century German script [2]. Kaempfer's other major written work was his *History of Japan*, appearing in English translation in 1727. In this he describes ginkgo nuts, calling them 'Ginau' and likening them to 'pistaches'. He observes that 'they grow very plentifully almost everywhere in Japan, on a fine tall tree, the leaves of which are not unlike the large leaves of an Adiantum'. For further information he refers his reader to his 1712 volume (Kaempfer, 1727: 116-7).

Kaempfer's discovery of the ginkgo in Japan was soon followed by the realisation it had originated in China, where it was located in many places in the eighteenth and nineteenth centuries. Korea was also found to be another stronghold of the species. However the trees that Western travellers found throughout the far east were cultivated specimens growing in gardens, notably around temples (**Fig. 3.1**). The species appears to have been spread further east from China around the twelfth century, presumably by Buddhist monks.

Some time after Kaempfer was in Japan, seeds were sent back to the Netherlands, perhaps through the agency of Kaempfer or his successors at the East India Company trading post. Probably around 1730, and certainly by the mid-eighteenth century, ginkgos were growing in European gardens. There is still an old tree in Utrecht that probably grew from the first lot of imported seed (Del Tredici, 1991: 5). Linnaeus formally named the tree *Ginkgo biloba* in 1771, referencing Kaempfer's *Amoenitatum exoticarum* (Linnaeus, 1771: 313); 'biloba' describing the leaf shape (Seward, 1900: 114). In 1797 a leading British botanist and friend of Sir Joseph Banks, James Edward Smith, proposed the name *Salisburia adiantifolia*, in honour of fellow botanist Richard Salisbury (Seward, 1919: 30) [3]. 'Adiantifolia' refers to the ginkgo leaf somewhat resembling a maidenhair fern leaf (*Genus* *Adiantum*), about the only thing its unique foliage does resemble. Smith's tag for the ginkgo attained some level of use during the nineteenth century. Robert Fortune, on his quest to get hold of Chinese tea plants, used it when describing the only very large trees he had encountered in the Shanghai district (**Fig. 4**) (Fortune, 1847: 129). It was eventually abandoned in favour of Linnaeus's nomenclature, which has remained current until the present day. As ginkgo is a gymnosperm, the genus was mostly regarded as related to the conifers, but with some taxonomists leaning to the cycads.

In 1896 a Japanese technician and self-taught botanist at the Tokyo Imperial University, Sakugoro Hirase (1856-1925), made a breakthrough discovery of swimming spermatozoids in ginkgo sexual reproduction (Crane, 2011, Seward 1919: 1). This led to a taxonomic rethink for ginkgos. Ultimately *Ginkgo biloba* was assigned to a monotypic family *Ginkgoaceae* in 1897 by the German botanist Alfred Engler, and then within a monotypic order *Ginkgoales* by the Russian botanist Ivan Gorozankin in 1904 (Barboni & Dutra, 2015: 421), within its own division of the plant kingdom *Ginkgophyta*. However the phylogenetic relationships of all the gymnosperm groups remain highly debatable (Zhou, 2009; Watson et al, 2001). *Ginkgo biloba* itself, or at least its genus, has probably existed since the Jurassic, and is claimed as the oldest pedigree of the plant world. The uniqueness of the group and its only living descendent is clear.

Ginkgos were being planted in North America from the late eighteenth century (Del Tredici, 1991: 5). They became popular and from then on they have been widely planted throughout the world (**Fig. 10**). Indeed the 'living fossil' tag helped make them popular on university campuses. Singleton's planting followed a well-established practice on North American campuses (Crane, 2011). But ginkgos were tough enough to become popular as street trees, even in big cities like New York. After the atomic bomb was dropped on Hiroshima, six ginkgos survived in the central radius of its impact; they soon budded and are still alive today. A temple was rebuilt around one of these trees.

This recent history underlines the 'living fossil' question. The current Wikipedia entry for *Ginkgo biloba* states: 'For centuries, it was thought to be extinct in the wild'. The 'in the wild' qualifier makes this almost true. Somewhat less than two hundred years after the ginkgo was brought to Europe, claims were made by nineteenth century travellers that ginkgos grew in the wild (Seward & Gowan, 1900), but botanists in the early twentieth century were sceptical (Seward, 1919). Chinese botanists confirmed their existence in the 1920s and in the 1950s identified the trees growing on the slopes of Tianmu Shan west of Hangzhou, Zhejiang Province (**Fig. 6**), as worthy of protection in a nature reserve (Del Tredici, 1992: 3). However these occurrences remained controversial. Examination of the Tianmu Shan trees made it unlikely, but nevertheless not possible to rule out their being planted in medieval times; there are three trees growing in front of a temple high on the mount (**Fig. 3.1**), undoubtedly planted, but many others of varying ages are growing in apparently natural positions.



Fig. 3.1. Three ginkgos in a row, growing in front of the Lion Temple, Tianmu Shan reserve.



Fig. 3.2. A fresh leaf from each tree at the temple, and one dead leaf; note the variable shape.

Other populations were discovered in Hubei Province in east-central China, and Guizhou Province and the Chongqing Municipality in the south-west. The largest of these, the Li Jiawan Grand Ginkgo King (Xiang et al, 2009), is in the *Guinness Book of Records* and is thought to be over 4,000 years old, an age achieved by the ginkgo's ability to grow multiple generations of shoots, forming multiple trunks, that keep the organism going as the older growth dies away. These very old trees make it difficult to determine whether a tree is naturally seeded, or can be attributed to some form of human activity. The references in early Chinese literature are suggestive of cultivation. The ginkgo nut is used as a food; the fruit and seed can be bought in Chinese markets today (**Fig. 5**). The leaf is regarded as having medicinal benefits, claims which are the cause of considerable research and much debate. However these uses do provide reasons why the tree may have been cultivated from ancient times, aside from possible religious beliefs.

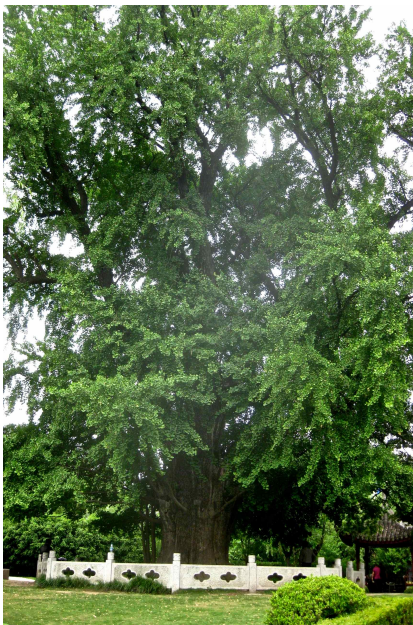


Fig. 4. The grand old ginkgo tree in Gusu Park, Jiading, a southern district of Shanghai. It is typical of the large old trees planted hundreds of years ago in numerous locations in China, Korea and Japan.



Fig. 5. Ginkgo nuts, shelled and unshelled, on sale in Jiading market.

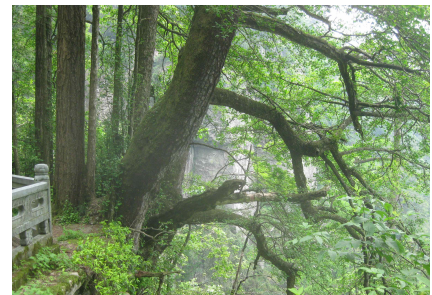


Fig. 6. The famous Family of Five Generations ginkgo growing on a cliff edge in Tianmu Shan Reserve. This multi-trunked tree is very old and probably wild, but genetic studies have been inconclusive. Locals refer to it as a dragon about to take flight.

Earlier genetic studies on the known ginkgo populations were inconclusive, but the levels of genetic variation did favour those in the south-west in particular as being wild. Recent research has provided fairly convincing evidence of wild populations in the Dalou Mountains, also in the south-west (Tang et al, 2012). Here the trees grow in natural forests, apparently free of human

interference, where the canopy tree profiles closely match those found in Pliocene and Pleistocene fossil deposits in southwest Japan, laid down before and during the formation of the East China Sea, and fitting neatly with what is known of the extent of the Pleistocene ice sheets. The ginkgos survived the Ice Ages in Chinese mountain refugia - quite like Australia's Wollemi pine - but only just [4].

Discovery of the Fossil Ginkgo

The eventual discovery of ginkgo in the fossil record is harder to verify but provides the more interesting history.

Assuming Kaempfer did introduce the ginkgo to the West, and to science, the first thing that strikes one is that in the 1690s, and indeed for many decades after, Western science was still a realm of fierce debate as to what fossils actually were. At the time a fossil was almost anything dug out of the ground (from the Latin 'to dig').

Ancient Greeks and Romans, including Ovid, had some knowledge and understanding of fossils, mainly from animals, such as shells and corals, but some awareness of plant fossilisation (McCartney, 1924). They did not have coal mining (see below), nevertheless considerable fossil beds were to be found within their territories, apparently arousing little interest. There is certainly no evidence they knew of the ginkgo. This situation seems to have persisted until at least the thirteenth century and Albertus Magnus (Ward 1885: 387). Late medieval scholars such as Magnus and Georgius Agricola began to pay more attention to fossils, mainly petrified wood. Ward (1885: 389) refers to Johann Daniel Major, a German professor of medicine, publishing an obscure work in 1664 - *Lithologia curiosa, sive de animalibus et plantis in lapides versis* - where fossil plants, leaves and foliage are first brought to the attention of European scholars.

Major's book seemed to have little influence, but other works began to follow: Robert Hooke's *Micrographia* 1665 included an item on petrified wood; Martin Lister published a paper in the Philosophical Transactions of London, 1673: *A Description of Stones figured like Plants, and by some Observing men esteemed to be Plants petrified*; Robert Plot published *The Natural History of Oxfordshire* in 1677 and *The Natural History of Staffordshire* in 1686; both works feature 'formed stones', i.e. fossils, although little on plant material. John Ray's massive *Historia Plantarum* published in three volumes 1686-1704 unfortunately contains no illustrations that might reveal a ginkgo. In 1699 Edward Lhuyd published *Lithophylacii Britannica Ichnographia*, one of the most important of the earliest works on palaeontology; it featured plenty of fossils, including illustrations of leaves and foliage. The year 1705 saw the publication of Robert Hooke's posthumous works; his lengthy *Discourse on Earthquakes* includes illustrations of petrified wood and possible fruit and seeds, and several pages of discussion on their nature. Leibnitz knew of fossil Indian plants in 1706 (Ward 1885: 396). Examination of these early works treating of fossils, which often feature meticulous drawings of specimens, fail to provide a single example of a ginkgo, or even ginkgo-like leaf or seed.

In fact it took time to focus on what were referred to as 'formed stones' as a class of objects in their own right, and deserving of explanation. In the debates over the nature of fossil origins, the protagonists fell roughly into two camps. There were those who believed they were not of organic origin at all, but meaningless or false phenomena or illusions, due to mechanical forces, some strange 'plays of nature' (*lusus naturae*), or even to the Creator testing the faith of men. The other camp believed they were real organic remains, but relicts of the biblical Deluge, a view largely created by Thomas Burnet who published his *Telluris theoria sacra* during the 1680s, with an English translation, *The Sacred Theory of the Earth*, in 1691. The latter group were at least on the right track, although the Deluge theory was still supported until the early nineteenth century by which time science had moved on. But on-going debate within the Deluge camp through the eighteenth century forced recognition that certain fossils must predate the Deluge, and eventually recognition that they must be of an age greater than could be accounted for by biblical history at all.

The great impetus for palaeobotany, a new discipline not yet defined, was the exploitation of European coal deposits. Coal mining had been undertaken at least since the Middle Ages but by the seventeenth century western Europe had exhausted its forest resources for firewood and building material. People were forced to dig coal for heating and the coal deposits, overwhelmingly from the Carboniferous (Ward, 1885: 388), were rich in fossil plants. This undoubtedly saw the discovery of many fossil species, and many that might justifiably be thought extinct, for example the *Glossopterids*. That is, if one could accept the idea of extinction, which was not to be the case for well over another hundred years. But whatever they were, fossils were becoming valuable for mapping the stratigraphy of coal and other resources.

The first comprehensive and well-illustrated treatise on fossil plants was by the Swiss scholar Johann Jakob Scheuchzer, the *Herbarium diluvianum* of 1709; his second edition in 1723 included 14 large plates of plant illustrations [5]. Another work, *Museum diluvianum* appeared in 1716 and included a fifteen page list of 'Plantae Diluvianae'. Scheuchzer began by believing in *lusus naturae* but after reading Burnet accepted that fossils were of organic origin, and a result of the Deluge. He corresponded with Burnet and wanted to take the latter's ideas further. He was the first to develop a stratigraphic concept (Schweizer, 2009: 96). But his enthusiasm for the Deluge lead into trouble. Like most of his contemporaries he believed species were immutable in number and form, all part of an invariable divine order. He searched for antediluvian humans until he famously claimed two extinct fossilised salamander skeletons found in a quarry were the remains of men drowned in the Deluge. Nevertheless his descriptions and illustrations gave him credit as possibly the first palaeobotanist [6].

Following on Scheuchzer, John Woodward made extensive catalogues of fossils (Woodward, 1728, 1729). He mentions some specimens of 'Adiantum' and was receiving specimens from Scheuchzer, but his descriptions are not even crudely scientific, nor in the main illustrated. There is little contribution to palaeobotany, but he does state: "That there are besides, repositied in Stone, and even in the firmest and hardest Strata, Leaves of various Kinds of Vegetables: and sometimes whole Trees; as also such Fruits as are durable, firm, and capable of being preserv'd, e. gr. Nuts, Pine-Cones, and the like. That, amongst the rest, there are discover'd, under Ground, Trees, Leaves, and Fruits of Vegetables, in Countries where such do not now spontaneously grow. Nay, that there are digg'd up Trees in great Numbers, and many of them very large in some Northern Islands, in which there are at this Day growing no Trees at all; and where, by reason of the great Bleakness and Cold of those Countries, 'tis probable none ever did, or could grow." (Woodward, 1728: 124). Woodward also thought that the Deluge was responsible.

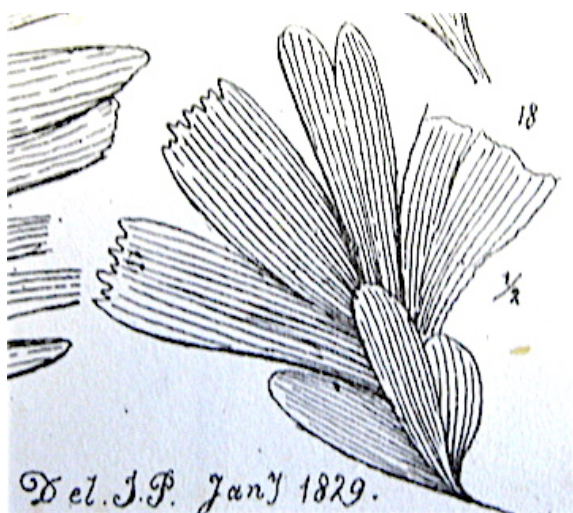
Many of the earliest specimens of ginkgoales that ultimately were found came from relatively accessible deposits on the coasts of England, but by Scheuchzer and Woodward's time there was still no sign of the ginkgo in the fossil record, and we have arrived at the point where Japanese seeds were already turning into trees in European gardens.

As with the *Glossopterids*, ginkgo leaves are important in the fossil record because their distinctive shapes and venation make their many fossil remains trustworthy for identification (Seward, 1900:119, Stopes, 1910: 14). In the course of time science has mapped the history of the ginkgoales; fossil evidence has accumulated. It shows them to have originated at least as far back as the early Triassic, with possible antecedents in the Permian, but no clear relationship to any taxa as far back as the Carboniferous. They are certainly pre-flowering plants, gymnosperms loosely related to the conifers and the cycads. The family was once common virtually all over the planet for geological ages. In the Mesozoic Era its fruits had been dinosaur food, but as the earth came into the late Tertiary Period the range and number of species of the ginkgoales shrank and shrank for reasons that are still mysterious. Whatever agents had spread their seeds - dinosaurs for one, and probably Tertiary mammal megafauna - were no longer on the job. After the Pleistocene Ice Ages the ginkgo was left on the brink of extinction.

In 1900 the great botanist and geologist A.C. Seward [7] published a seminal paper with Miss J.

Gowan: *The Maidenhair Tree* (*Ginkgo biloba*, L.) (Seward & Gowan, 1900). They recounted claims of wild populations. Also, with reservations, they discussed various fossils thought to be ginkgo from the Palaeozoic. Then in 1919 Seward published the final volume of a landmark four volume work: *Fossil Plants: a text-book for students of botany and geology*. Volume four described the Ginkgoales. In it he stated: "*Ginkgo biloba* has a pre-eminent claim to be described in Darwin's words as 'living fossil'" (Seward, 1919: 1). By this time he was sceptical that any wild populations had survived, and appears to have discounted the claims of Palaeozoic fossils. He was also dubious of any of the known examples of petrified wood assigned to ginkgo species. Recent work confirms Seward's doubts about the Palaeozoic, and firms up evidence from the Triassic (Zhou, 2009). The fossil evidence for this history was slow to emerge, but we can trace its emergence.

Adolphe Brongniart is generally regarded as the father of palaeobotany. His seminal work *Histoire des Vegetaux Fossiles* (1828-1837) features about 200 beautifully illustrated plates. There are drawings of the leaves of Jurassic species from the Yorkshire Oolite named in the genus *Cyclopteris* that bear a resemblance to ginkgos, but ginkgos as such are not listed in his 'Table des Matieres' nor to be found in the earliest plates. He also published a *Prodrome* (1828b) based on the same material. These works included *Cyclopteris flabellata*, *C. obliqua* and *C. orbicularis*. Brongniart was thinking of ferns; *Cyclopteris* species are fern related. But he was getting close.



In 1829 John Phillips published a two-volume treatise on the fossils of the Yorkshire coast. It included a widespread Jurassic species (Phillips 1829, 1829: Pl.VII, Fig. 18) that is possibly the first fossil ginkgo discovered, or at least described, almost 100 years after the introduction of the living tree to the West (**Fig. 7**).

Phillips obtained his specimen from a certain Mr. Bean who found rich plant fossil deposits in the coastal cliffs at Scalby near Scarborough in 1827; he refers to 'Mr. Bean's Cabinet' (Phillips 1835: 181). He figured and described the species as another fern relative and suggested the name *Sphaenopteris? latifolia*.

Fig. 7. John Phillips' illustration of *Sphaenopteris? latifolia*. [Reproduced courtesy of the Baillieu Library Special Collections, Melbourne University.]

The attached query was pertinent. Phillips and Bean were members of the Yorkshire Philosophical Society. They corresponded with Brongniart, deferred to his authority, and sent him specimens. A year later in 1830 Brongniart revised his Plate 61. He had already used Phillips' name in 1828 for a Carboniferous fern, and figured another Yorkshire Oolite specimen from the Philosophical Society as *Cyclopteris digitata* (**Fig. 8**).

Another important work came soon after Brongniart's from the English palaeobotanists John Lindley and William Hutton: *The Fossil Flora of Great Britain*, in three volumes (1831-3-7). Again there are specimens illustrated that resemble ginkgos and actually were, such as *Cyclopteris digitata* (they follow Brongniart; Lindley & Hutton, 1831: 179) and possibly *Sphenopteris adiantoides*. The illustration for *Sphenophyllum schlotheimii* (**Fig. 9**), a Carboniferous fossil from Somerset coal, is actually accompanied by an illustration of the leaf of '*Salisburia adiantifolia*' to drive the point home; and the similarity is noted again for *Noeggerathia flabellata*. This at least proves that early palaeobotanists were well aware of *Ginkgo biloba* and alert to it should specimens be found. However none are identified as such in any of these works.

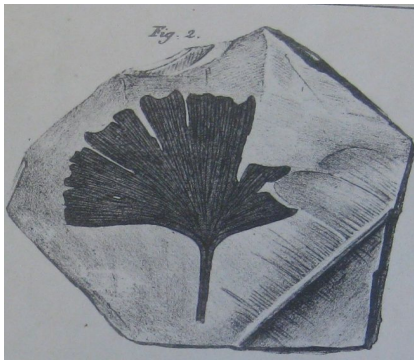


Fig. 8. Difficulties differentiating and relating fossil leaf forms as nineteenth century science develops the new field of palaeobotany. This leaf of a Jurassic *Cyclopteris digitata* figured in Brongniart's *Histoire* in 1830 is actually a ginkgo.

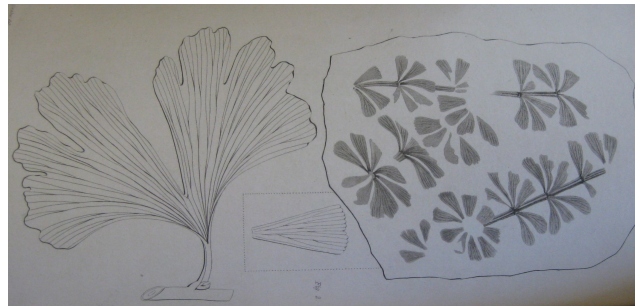


Fig. 9. Lindley and Hutton compared *Ginkgo biloba* (left) to a Carboniferous gymnosperm *Sphenophyllum schlotheimii*. It shows why early workers thought the ginkgo could be traced back into the Palaeozoic.

[Reproduced courtesy of the Baillieu Library Special Collections, Melbourne University.]

If this all seems confused, it is, and for a reason. Although the leaves of *Ginkgo biloba* have such a distinctive shape, they vary it quite a lot (**Fig. 3.2**), and it can be taken as highly probable that species extant in the Mesozoic and Tertiary also displayed this trait. It was very difficult for early palaeobotanists to differentiate and assign species to specimens solely on leaf shape, especially when the number of specimens was still small, but even later when they were abundant, especially for the Jurassic (Seward, 1919: 15, Watson et al, 1999: 720). There was no 'eureka moment' when ginkgo was discovered in the fossil record. It took decades to gather enough specimens, including seeds and stems, and study them thoroughly enough to begin to clarify species identification, and realise that in fact Phillips, Brongniart and others had already found them without knowing it.

Over forty years later Oswald Heer (1809-1883), another pioneering palaeobotanist, pointed out the very close resemblance of the Jurassic *Cyclopteris* specimens, especially *digitata*, and the ginkgo (Heer, 1877: 40-44). Heer was the beneficiary of excellent ginkgo specimens from Spitzbergen and Siberia; he adopted the generic designation *Ginkgo* for many of these Jurassic specimens; *Cyclopteris digitata* became *Ginkgo digitata* (Feistmantel, 1877: 196; Seward, 1919: 14).

In time the picture did emerge through the work of many of the pioneers of palaeobotany. Ginkgos were found in the Lower Cretaceous Wealdon sediments on the southern coast of England and many other sites. The type location is in the German Wealdon (Watson et al, 1999: 726). Some came from the Jurassic Stonesfield Slate in Oxfordshire, famous as a roofing tile and where the first dinosaur was found. David Lyall, the Scottish botanist, collected specimens off the coast of Greenland in the early 1850s (Seward, 1919: 30) [8]. They were all around the northern hemisphere, right up to Spitzbergen, but also some came from Gondwanan lands: India, South Africa and Australia (Douglas, 1983: 5). Ultimately they have been found on all continents. The early Indian specimens were Jurassic, and described by the British palaeontologist Ottokar Feistmantel (Seward, 1919: 23, 485), who was working on the 'Gondwana System' [9]. The *Glossopterids* he described are a group which may have some relevance to the evolution of the ginkgo, but any Palaeozoic links remain vague. Occupation of Gondwana notwithstanding, the Laurasian supercontinent was the stronghold of the ginkgoales, its probable place of origin, and its territory the ultimate refuge. But the fossil record, while showing the geographic and chronological range of ginkgos, still remains sketchy today in terms of its evolutionary biology (Zhou & Zheng, 2003).

By the turn of the twentieth century the *ginkgoales* had become a specialty subject of the newly emerging discipline of palaeobotany. In the first decades of the century there were perhaps half a dozen scholars who took on this mantle. One of them was Marie Stopes, who later gained fame for her advocacy of women's rights and birth control. The ginkgo played a role in her story. She studied Jurassic specimens from the Sutherland coast in Scotland. In 1905 she met Robert Scott. She urged

him to take his wife and herself to Antarctica on what was to be his fatal expedition. After what must have been a protracted effort by Stopes, Scott declined, writing her a letter in 1909 putting an end to the idea, but also promising to find fossils for her (Chaloner, 2005: 129; Watson, 2005: 239). When he and his colleagues' bodies were found there were fossil plants with them, notably *Glossopteris*. The fossils were described by Seward who declared Antarctica the missing piece of Gondwana, the ancient supercontinent.

Stopes continued her research in palaeobotany and met Kenjiro Fujii (1866-1952). Unlike Hirase (who had achieved fame), he was a professor at the Tokyo Imperial University and a world expert on *Ginkgo biloba*; he had also published work on ginkgo reproduction (Seward, 1900:125). Stopes fell in love with him and went to Japan, combining her affair with palaeobotanical research. She was thrilled to repeat Hirase's observations at the Imperial University, and to explore Hokkaido coal mines. The relationship ended and Stopes returned to her base in Manchester and continued her long career. She wrote a popular first textbook on palaeobotany, *Ancient Plants*, published in 1910, and for four years published *Sportophyte*, a 'journal of botanical humour' (Chaloner, 2005: 132). As contributing editor she probably wrote a featured poem, *A Botanical Dream*. The first verse ran:

Last night as I lay dreaming
There came a dream so fair
I stood mid ancient Gymnosperms
Beside the Ginkgo rare.

Conclusion

Absence of evidence of course is not evidence of absence. It is possible that some someone in some European country stumbled on a fossilised ginkgo leaf some time pre-1690 and published a description of it in a journal of the day and thus established the first Western knowledge of the genus, or at least the order. An absolutely exhaustive search for such an item may not be possible. However, as Major's book indicates, it takes more than such an event to make something 'known to science'. The research presented in this paper strongly indicates that, in the unlikely event such a publication did take place, it did not come to the notice of the general scientific community, which was burgeoning by the late seventeenth century, and taking an increasingly intense interest in fossils, and that it therefore could not substantiate a claim such as 'scientists thought it extinct until it was discovered growing in the East'.

The living tree was well-known in Europe and even parts of North America long before the fossil evidence. The 'living fossil' tag was applied because *biloba* was the only survivor of a complex, widespread and geologically long-lasting plant phylum. But also perhaps because it was thought extinct in the wild for a certain period. Stopes stated: 'It belongs to the fossil world, as a belated November rose belongs to the summer' (Stopes, 1910: 98). That has also proved incorrect, although its distribution is minuscule compared to that in past geological ages. F.A. Singleton's planting helped spread *Ginkgo biloba* again, but also gave us something perhaps more important, an enduring fascination with and love of the tree.



Fig. 10. Groves of young ginkgo trees on the slopes below the visitor centre at the National Arboretum Canberra, Australian Capital Territory.

Notes

1. It is the first record quoted in the *Oxford English Dictionary*.
2. In Chinese the pinyin name is *yin xing*, meaning 'silver apricot', for the female ginkgo's fruit.
3. Smith also founded the Linnean Society.
4. There are two other well-known instances of trees that fit the 'living fossil' appellation more literally than the ginkgo. The 'Wollemi pine' *Wollemia nobilis* was discovered in 1994 in a remote valley north-west of Sydney. The fossil record of the genus stretches back to the early Mesozoic and was known well before the living tree was found. It is a species of the family *Araucariaceae* rather than a true pine, i.e. a Gondwanan plant. It has since been widely propagated.



It is interesting to note here that the other tree, the Dawn Redwood *Metasequoia glyptostroboides* was first discovered and described from fossils by a Japanese in 1941. Only two years later living specimens were collected in a remote valley in south-west China. Their correct identification took another two years. The subsequent descriptions were not published until later in the 1940s owing to the war. The discovery was widely reported by the press and radio at time (Ma, 2003). Like both the ginkgo and the Wollemi pine, this tree is now also widely cultivated. One wonders if this example became conflated with the story of the ginkgo.

(Left) Dawn Redwood *Metasequoia glyptostroboides* in the Royal Botanic Gardens, Melbourne.

5. Scheuchzer's son John Gaspar Scheuchzer, a protege of Sir Hans Sloane, translated Engelbert Kaempfer's *History of Japan* into English, published in 1727; it became the definitive text on Japan for over a hundred years when Japan was closed to the West.
6. The term was not coined until 1885 by Lester Ward, a pioneering American sociologist who had been a geologist and palaeontologist for the US Geological Survey (Ward, 1885: 363).
7. Albert Charles Seward was co-editor of Charles Darwin's letters, with son Francis Darwin.

8. Lyall had been to New Zealand and Antarctica collecting with his friend Joseph Hooker, and on this occasion was on the Belcher Expedition in search of Sir John Franklin, 1852-1854 (Lyall, 2010: 37).
9. Feistmantel corrected an earlier description of *Cyclopteris lobata* (Feistmantel, 1876a: 35; 1876b: 126) to *Ginkgo lobata*, following Heer (Feistmantel, 1877: 197). He had published a geological paper in 1876 using the term 'Gondwana' in which he included descriptions of *Glossopteris* species, the defining plant taxa of the ancient supercontinent (Feistmantel, 1876a: 28). His paper is given as the first actual (rather than proposed) usage of the term in the *Oxford English Dictionary* although there are a number of prior occurrences in earlier ethnographical publications.

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