A living fossil is an organism that has survived the extinction of others in its group. A stricter definition is an organism that was first known only as a fossil, then discovered in living form. The most famous example in the animal kingdom is the coelacanth (a rare order of fish), while in the plant kingdom the best known is the Wollemi pine.

I first heard of the ginkgo tree as a living fossil when I was a geology student at the University of Melbourne in the early 1960s. There were two ginkgo trees, a male and a female, growing on either side of the entrance to the Geology Department on the Parkville campus (see below). Only one remains today, the female, and it is recorded on the City of Melbourne's Exceptional Tree Register.1

The trees were planted from seed, probably in the mid-1940s, by a professor of geology, Frederick Alexander Singleton (1897–1947), because of their fossil history. A later professor of botany, Carrick Chambers, remarked on Singleton's achievement in planting the male and female within pollinating distance.2 I had understood the legend was told with the strict definition of a living fossil, and decided to investigate.

Discovery of the living ginkgo

The ginkgo is recorded in some early Chinese literature.3 It is possible the plant itself was known to Europeans in China as early as the 16th century, but the first known European contact with the ginkgo is well documented, by Engelbert Kaempfer (1651–1716), a German-born physician and botanist working for the Dutch East India Company. In 1690 Kaempfer was posted to Japan, where the company had a trading post in Nagasaki. During this period Europeans were generally confined to an artificial island in Nagasaki Harbour, called Deshima (or Dejima), a structure designed in the distinctive shape of the ginkgo leaf.4

Kaempfer found that the tree was held in high regard by the Japanese. He published his findings in two works, of which copies are now held in the Rare Books Collection in the Baillieu Library. In Amœnitatum exoticarum of 1712 there is a description with line drawings of foliage, fruit and seeds, and it is this account that gives us the name
(see p. 40). He states it to be ‘Ginkgo’, the word derived from the Japanese Gin an. Kaempfer’s History of Japan, appearing in English translation in 1727, describes ginkgo nuts, calling them ‘Ginau’ and likening them to ‘pistaches’. Kaempfer observes that ‘they grow very plentifully almost everywhere in Japan, on a fine tall tree’.5

It was soon found that the ginkgo had originated in China, and that Korea was also a stronghold of the species. However, the trees that Western travellers found throughout the Far East were cultivated specimens growing in gardens, notably around temples, presumably planted by Buddhist monks.

Seeds were sent back to the Netherlands and, by the mid-18th century, ginkgoes were growing in European gardens. There is still an old tree in Utrecht that probably grew from the first imported seed. Linnaeus formally named the tree Ginkgo biloba in 1771, ‘biloba’ describing the leaf shape. A gymnosperm, Ginkgo biloba was assigned ultimately to a monotypic family, Ginkgoaceae, within a monotypic order, Ginkgoales, within its own division of the plant kingdom, Ginkgophyta. The uniqueness of the group and its only living descendant is clear.
Ginkgoes became popular and have been widely planted throughout the world. The ‘living fossil’ tag helped make them popular on university campuses—Singleton’s planting followed a well-established practice on North American campuses. Ginkgoes 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 ginkgoes within the inner radius of its impact survived the blast; they soon budded and are still alive today.

In the 1950s, Chinese botanists identified ginkgoes growing on the slopes of Tianmu Shan, west of Hangzhou in Zhejiang Province, as wild trees worthy of protection (see opposite, above).  

Other similar populations were also discovered in China, but the great age of the trees made it difficult to determine whether they had been naturally seeded, or could be attributed to some form of human activity. The female ginkgo’s fruit (see p. 44), called yin xing in Pinyin, meaning ‘silver apricot’, is used as a food, and the leaf is regarded as having medicinal benefits, so the tree may have been cultivated since ancient times.

Earlier genetic studies of ginkgo populations were inconclusive, but...
Recent research has confirmed at least one wild population in south-western China, where the trees grow in natural forests apparently free of human interference. The canopy tree profiles closely match those found in fossil deposits, fitting neatly with what is known of the extent of the Pleistocene ice sheets during the last two million years. Like Australia’s Wollemi pine, the ginkgo survived the Ice Ages in mountain refugia—but only just.

**Discovery of the fossil ginkgo**

In Kaempfer’s time, Western science was a realm of fierce debate as to what fossils actually were, but descriptions of fossils, including plants, had begun to be published. An impressive range of the key works is to be found in the Baillieu Library’s Rare Books Collection. Robert Hooke’s *Micrographia* (1665) includes an item on petrified wood; in 1673 Martin Lister published a paper in the Philosophical Transactions of the Royal Society: ‘A description of stones figured like plants, and by some observing men esteemed to be plants petrified;’ and Robert Plot published *The natural history of Oxford-shire* in 1677 and *The natural history of Staffordshire* in 1686; both works feature ‘formed stones’ (fossils), although little on plant material. John Ray’s massive *Historia plantarum*, published in three volumes between 1686 and 1704, unfortunately contains no helpful illustrations.

In 1699 Edward Lhuyd published *Lithophylacii Britannici ichnographia*, one of the most important of the earliest works on palaeontology; it features plenty of fossils, including illustrations of leaves and foliage. Robert Hooke’s posthumously published works (1705) include his lengthy *Discourse on earthquakes*, with illustrations of petrified wood, fruit and seeds. But these and other early works, which often feature meticulous drawings of specimens, fail to provide a single example of a ginkgo, or even a ginkgo-like leaf or seed.

In the debates over the nature of fossil origins, the protagonists fell roughly into two camps: those who believed fossils were not of organic origin but strange ‘plays of nature’ (*lusus naturae*), versus those who believed they were real organic remains, but relics of the biblical Deluge.

The first comprehensive and well-illustrated treatise on fossil plants was by Swiss scholar Johann Jakob Scheuchzer: the *Herbarium diluvianum* of 1709; his second edition (1723) includes 14 large plates of plant illustrations. Another
work, *Museum diluvianum*, appeared in 1716 and includes a 15-page list of ‘Plantae diluvianae’. Convinced of the Deluge, Scheuchzer was the first to develop a stratigraphic concept.

John Woodward, in his 1729 work *An attempt towards a natural history of the fossils of England*, made extensive catalogues of fossils, but his descriptions contribute little to palaeobotany. Intriguingly, he did state elsewhere:

That there are besides, reposed 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.

By Scheuchzer’s 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.

The fossil evidence for ginkgoes was slow to emerge but, turning again to the Rare Books Collection, we can trace its emergence. Adolphe Brongniart is generally regarded as the father of palaeobotany. His seminal work *Histoire des végétaux fossiles* was published in sections from 1828 to 1837. He also published a Prodrome based on the same material. The *Histoire* features some 200 beautifully illustrated plates. Ginkgoes are not found in the earliest plates, but there are drawings of the leaves of Jurassic species named in the genus *Cyclopteris* that bear a resemblance. He was getting close.

In 1829 John Phillips published a two-volume treatise: *Illustrations of the geology of Yorkshire*. Its listing of fossils on the Yorkshire coast included a widespread Jurassic species that is probably the first fossil ginkgo discovered, or at least described, almost 100 years after the introduction of the living tree to the West. Phillips obtained his specimen from a certain Mr Bean, who in 1827 had found rich plant fossil deposits in the cliffs near Scarborough. Phillips suggested the name *Sphaenopteris? latifolia*. 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 Brongniart revised his Plate 61 and included a new specimen from the Yorkshire coast. He had already used Phillips’ name for a species of fern and figured the new plant as *Cyclopteris digitata* (opposite, above).

Another important work came just after Brongniart’s, from John Lindley and William Hutton: *The fossil flora of Great Britain*, in three volumes (1831–37). *Cyclopteris digitata* features again, and other similar species. One illustration includes a ginkgo leaf for comparison (pictured opposite, below); early palaeobotanists were well aware of *Ginkgo biloba* and alert to it should specimens be found, although none is identified as such in any of these works.

This confusion was because the leaves of *Ginkgo biloba*, although they have a distinctive shape, vary quite a lot (see p. 45). It was very difficult for early palaeobotanists to differentiate and assign species solely on the leaf shape of specimens. There was no eureka moment, when the ginkgo was discovered in the fossil record; rather,
it took decades for botanists to gather enough specimens, including seeds and stems, and study them thoroughly enough to begin to clearly identify species, and realise that in fact Phillips, Brongniart and others had already found ginkgoes without knowing it.

It was more than 40 years later that Oswald Heer, another pioneering palaeobotanist, pointed out the very close resemblance of the Jurassic *Cyclopteris* specimens, especially *digitata*, to the ginkgo. 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*.21

The fossil record of today shows ginkgoes to have originated at least as far back as the early Triassic (about 235 million years ago). *Ginkgo biloba* itself, or at least its genus, has probably existed since the Jurassic (perhaps 180 million years ago), and is claimed as the oldest pedigree of the plant world. In the late Tertiary Period (after about 20 million years ago) the range and number of species of the Ginkgoales shrank, for reasons that are still mysterious.

By the turn of the 20th century, ginkgo fossils had been found in many sites on all continents and the Ginkgoales had become a specialty

Left: This leaf, called *Cyclopteris digitata* by Brongniart, is actually a ginkgo. Adolphe Brongniart, *Histoire des végétaux fossiles* (1828–37), facsimile edn, Berlin: W. Junk, 1915, Plate 61 bis, Fig. 2. Vallance Collection, Rare Books Collection, University of Melbourne Library.

subject of the newly emerging discipline of palaeobotany. In 1919 the botanist and geologist A.C. Seward published the final volume of *Fossil plants: For students of botany and geology*. Volume 4 described the Ginkgoales. In it he stated: ‘*Ginkgo biloba* has a pre-eminent claim to be described in Darwin’s words as “living fossil”’.22

In the first decades of the century there were perhaps half-a-dozen scholars who were experts on Ginkgoales. One of them was Marie Stopes, who later gained fame for her advocacy of women’s rights and birth control. In 1905 she met Robert Scott and urged him to take his wife and her to Antarctica on what was to be his fatal expedition. After what must have been a protracted effort by Stopes, Scott refused, writing her a letter in 1909 putting an end to the idea, but also promising to find fossils for her. When the bodies of Scott and his colleagues were found, there were fossil plants with them.

Stopes continued her research in palaeobotany and met Kenjiro Fujii, a professor at the Tokyo Imperial University and a world expert on *Ginkgo biloba*. Stopes fell in love with him and went to Japan, combining her affair with palaeobotanical research. After the relationship ended she returned to her base in Manchester and continued her long career. She wrote a popular first textbook on palaeobotany, *Ancient plants*,23 and for four years published *Sportophyte*, a ‘journal of botanical humour’. As contributing editor she probably wrote a featured poem, *A botanical dream*, which begins:

> Last night as I lay dreaming
> There came a dream so fair
> I stood mid ancient Gymnosperms
> Beside the Ginkgo rare.24

**Conclusion**

My research indicates that we cannot substantiate for the ginkgo a claim of living fossil in the strict sense of the term. The living tree was well known in the West long before the fossil evidence was uncovered. The ‘living fossil’ tag was applied because *Ginkgo biloba* was the only survivor of a complex, widespread and geologically long-lasting plant phylum, but also because it was thought to be 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’. F.A. Singleton’s planting at the University of Melbourne helped spread *Ginkgo biloba* again, but also gave us something perhaps more important: an enduring fascination with, and love of, the tree.
A fresh leaf from each ginkgo tree at the temple on Tianmu Shan; note the variable shape. Photograph by Craig Robertson.

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Craig Robertson is a Melbourne author. His books include Buckley’s hope (Scribe, 1980) and Song of Gondwana (Penguin, 1989).

The University of Melbourne’s Rare Books Collection, held in the Baillieu Library, holds a number of important collections of early botanical, geological and palaeontological texts, including the Vallance Collection, Earth Sciences Rare Books, Botany Rare Books (particularly strong in 18th-century books), and the Sophie Ducker Collection, as well as volumes documenting early European voyages of exploration. To request books, which can be viewed in the Cultural Collections Reading Room in the Baillieu Library, see http://library.unimelb.edu.au/collections/special-collections/rare-books.

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20 John Phillips, Illustrations of the geology of Yorkshire: Part 1: The Yorkshire coast, York: Printed for the author, by Thomas Wilson and Sons, 1829, pp. 119, 120, 152, 181; Plate 7, Fig. 18. Earth Sciences Rare Books Collection, University of Melbourne Library.
23 Marie Stopen, Ancient plants: Being a simple account of the past vegetation of the Earth and of recent important discoveries made in this realm of nature study, London: Blackie & Son, 1910, p. 98.