Two Thousand Years of Eating Bark: *Magnolia officinalis* var. *biloba* and *Eucommia ulmoides* in Traditional Chinese Medicine

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With a sense of urgency inspired by the rapid disappearance of plant habitats, most researchers are focusing on tropical flora as the source of plant-based medicines. However, new medicines may also be developed from plants of the world's temperate regions.

While working in his garden in the spring of 1763, English clergyman Edward Stone was positive he had found a cure for malaria. Tasting the bark of a willow *(Salix alba)*, Stone noticed a bitter flavor similar to that of fever tree (*Cinchona* spp.), the Peruvian plant used to make quinine. He reported his discovery to the Royal Society in London, recommending that willow be tested as an inexpensive alternative to fever tree. Although experiments revealed that willow bark could not cure malaria, it did reduce some of the feverish symptoms of the disease. Based on these findings, Stone's simple taste test led to the development of a drug used every day around the world: willow bark was the first source of salicylic acid, from which Bayer chemist Felix Hoffman synthesized aspirin (acetylsalicylic acid) in 1899.

The recent search for new plant-based medicines has focused on tropical species, but aspirin is not the only drug derived from garden plants of the temperate zones: the antitumor agent taxol and the heart stimulant digitoxin come from plants found in front yards across North America. During random screening of plant material in 1980, the U.S. National Cancer Institute discovered taxol in the bark of the endangered Pacific yew *(Taxus brevifolia)*. Since then, chemists have developed a method for extracting the active compound from the needles of the English yew *(Taxus baccata)*, a species common in cultivation. Foxglove *(Digitalis purpurea)*, the source of digitoxin, had a long history as a folk medicine in England before 1775, when William Withering found it to be an effective cure for dropsy. Doctors now prescribe digitoxin as a treatment for congestive heart failure.

EGb 761, a compound extracted from the maidenhair tree *(Gingko biloba)*, is another example of a drug developed from a plant native to the North Temperate Zone. Used as an herbal remedy in China for centuries, ginkgo extract is now packaged and marketed in the West as a treatment for ailments ranging from short-term memory loss to impotence. Although the claims made for the extract might seem too miraculous to be true, research has shown that ginkgolides (the active ingredients in EGb 761) do have a beneficial effect on symptoms associated with aging.[1] Inspired by these results, pharmaceutical companies have established ginkgo plantations in Europe, China, and the United States.

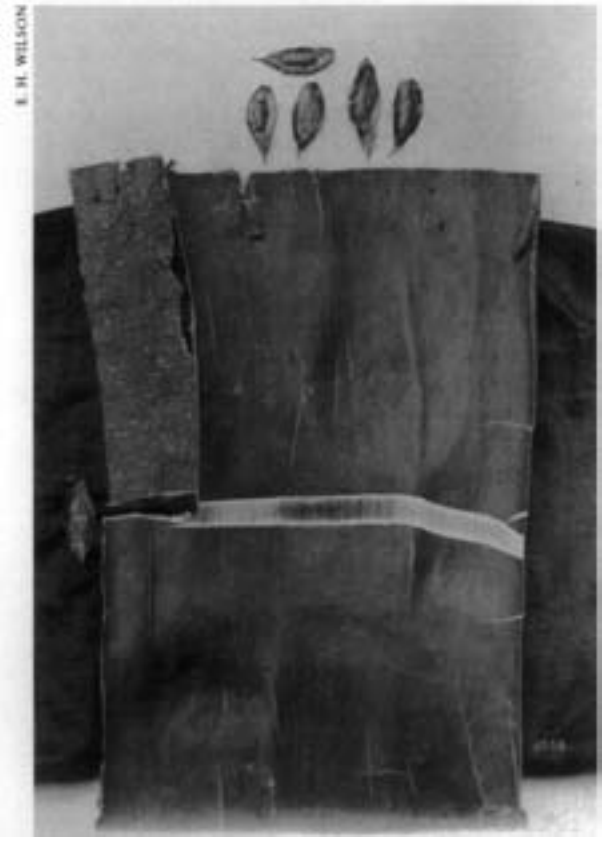
Gingko is only one of many Chinese plants used as medicine. With an estimated 3,118 indigenous genera and more than 25,000 native species of seed plants, the flora of China is the largest and most diverse in the North Temperate Zone.[2] For thousands of years, practitioners of traditional Chinese medicine have developed treatments from plants, changed these treat-

ments in response to empirical research and availability of raw materials, and documented their findings in herbals. Trade within China has enabled herbalists in Kunming to use the same plant materials as herbalists in Beijing, over a thousand miles away. Always searching for better cures, the Chinese have also looked to the rest of the world for useful plants: as early as the eighteenth century, the Chinese were importing American ginseng *(Panax quinquefolius)* from eastern North America to complement their own medicinal plants.

The documentation of traditional Chinese medicine goes back to the Han Dynasty (206 BC–220 AD). Written in approximately 100 BC, *Sheng Nong Ben Cao Chien* (The Herbal Classic of the Divine Plowman) is China's earliest known pharmacopoeia. This materia medica lists 365 traditional remedies, including 252 derived from plants, categorized into three classes based on toxicity: first-class remedies with no adverse side effects, used regularly to promote overall health; middle-class remedies, applied carefully to treat a smaller range of ailments; and lower-class remedies with potentially dangerous side effects, used to treat specific illnesses. *Sheng Nong Ben Cao Chien* gives general advice on the application of these remedies and specific instructions for their identification, preparation, and use.

Among the plants mentioned in this two-thousand-year-old work are joint fir *(Ephedra sinica)* and ginseng *(Panax ginseng)*, both of which have been appropriated by Western medicine. Joint fir is the source of ephedrine, an active ingredient in asthma and hay fever medicines. Ginseng, an important herbal medicine in China, is gaining popularity in the West as an adaptogen—a drug used to treat a variety of symptoms, to increase resistance to pathogens, and to promote general health. Research has shown that the active substances in ginseng

Eucommia ulmoides *in the Hangzhou Botanic Garden is elaborately sheathed to protect it from local bark harvesters. Even though most herbalists remove only part of the bark from a given tree, the popularity of the drug that is derived from* Eucommia ulmoides *makes every tree vulnerable to damage or even death from harvesting*



The bark of Eucommia ulmoides *was photographed by E. H. Wilson in China in 1907. The white band of fibers in the middle of the slab is the latex that gives the tree its common name, the hardy rubber tree*

stimulate nerve centers, improve the metabolism and vascular system, and lower cholesterol levels.[3]

While ginseng and ephedrine are familiar to many Westerners, some Chinese medicinal plants are essentially unknown outside China. Two of these plants, *Eucommia ulmoides* and *Magnolia officinalis* var. *biloba*, grow in the Arnold Arboretum. Many Chinese use soups, pills, teas, and tinctures made from dried eucommia leaves and bark to lower blood pressure and increase strength. Herbal practitioners prescribe magnolia bark to treat coughs and colds and use magnolia flower buds to improve digestion and ease menstrual cramps. Both species are uncommon in cultivation outside China but will grow in Boston gardens.

Eucommia ulmoides

A medium-sized, deciduous tree with lustrous, serrate leaves and inconspicuous, unisexual flowers, *Eucommia ulmoides* is the sole species in the Eucommiaceae. Native to the Tsinling Mountains in central China, eucommia was not seen by Western botanists until 1886, when specimens collected by Augustine Henry, a British customs official, trained medic, and amateur botanist, arrived at Kew Gardens. It was first grown in Europe in 1892, from seeds sent by French missionary Paul Farges to Maurice de Vilmorin, a Parisian plantsman. Its common name, the hardy rubber tree, refers to the white strands of latex found in its inner bark, leaves, and fruit. This latex attracted the attention of Europeans as early as 1903 when *The Gardener's Chronicle* claimed "there is good reason for believing that it would be worth while to plant [eucommia] in the warmer parts of the British Isles as a probable source of rubber."[4] Though the Chinese do produce some rubber from eucommia, it is not of high enough quality to be a replacement for the traditional, tropical source of rubber, *Hevea brasiliensis*.

The Chinese value eucommia more for its therapeutive properties than its latex. *Sheng Nong Ben Cao Chien* lists duzhong, the medicine derived from eucommia bark, in the first class of remedies, claiming it "revitalizes the internal organs, increases prowess, strengthens the bones, muscles, and tendons . . . and delays aging when taken continuously."[5] Augustine Henry found duzhong to be potent, telling William Watson of Kew Gardens that it is "tonic, invigorating, and . . . a most valuable drug with the Chinese, selling at 4s to 8s a pound."[6]

Farmers harvest eucommia in April, when the bark can be easily removed from the trunk of the tree. The process involves a number of steps. First, harvesters peel bark from trees with a diameter of greater than six inches, being careful not to girdle and kill the plants. They then tie the strips of bark together in bundles and sweat them under straw for a week or until the white inner bark turns black. Next, they lay the strips in the sun, drying the bundles so they can remove the outer bark, leaving only the stringy inner bark. They then chop the strips of inner

Magnolia officinalis *var.* biloba, *approximately twenty feet tall, in the Arnold Arboretum This plant was grown from seed sent by the Hangzhou Botanic Gardens in 1981.*

bark into blocks and send them to market. Herbalists prepare these blocks according to a number of different recipes, depending on the needs of the patient.[7]

There are twelve accessions of eucommia represented in the collections of the Arnold Arboretum, including AA #14538-A, received as a plant from the Veitch Nursery Company of England in 1907. It is likely that this plant was grown from seed collected by E. H. Wilson in 1900 on his first trip to China for the Veitch firm. Almost ninety years old, this tree is now thirty feet tall with a spread of about twenty feet. Although no direct provenance information is available for this accession, Wilson's description of eucommia in *Plantae Wilsonianae* indicates that it is probably of garden origin. Wilson reported that he found no eucommia of indisputably wild provenance, apparently the result of overharvesting.[8] However, due to wide cultivation, the species is not in danger of extinction: farmers grow the tree in plantations in Sichuan, Hubei, Shaanxi, and Guizhou provinces, exporting the bark throughout the rest of China.

Magnolia officinalis

The Chinese also cultivate *Magnolia officinalis* for its medicinal properties. *The China Plant Red Data Book* lists this unusual magnolia, native to central China (Hubei, Sichuan, Guizhow, and Guangxi Provinces), as vulnerable, with most of its wild population destroyed by the over-harvesting of its valuable bark.[9] *Magnolia officinalis* is a fast-growing deciduous tree with large, obovate leaves and fragrant white flowers as large as twelve inches in diameter. In its native range, it occurs at elevations of nine hundred to six thousand feet, generally reaching a height of forty-five feet in full sun and well-drained soil.

This species has been plagued by taxonomic confusion since 1885, when it was first collected in Hubei Province by Augustine Henry. Nearly identical in appearance to *Magnolia hypoleuca,* a closely related Japanese species, it was identified as such until 1913, when E. H. Wilson and Alfred Rehder examined specimens Wilson had collected for the Arnold Arboretum in Hubei six years earlier. Rehder and Wilson gave the Chinese plant the species epithet *officinalis,* Latin for "of the shops," to signify its medicinal importance. They also named a variety, *Magnolia officinalis* var. *biloba,* distinguished from the type variety by the deep notches at the leaf apices and a slight variation in its native range (native to southeastern China—Hubei, Jiangxi, Zhejiang, Fujian, and Hunan Provinces). The bark of both is used as an herbal remedy.

In their description of *Magnolia officinalis* in *Plantae Wilsonianae,* Alfred Rehder and E. H. Wilson wrote, "the Chinese designate this species 'Houpo' tree, and its bark and flower buds constitute a valued drug which is exported in quantity from central and western China to all parts of the empire." *Sheng Nong Ben Cao Chien* lists houpo in the third class of remedies

The spectacular foliage of Magnolia officinalis *var.* biloba.

because its active ingredient, the alkaloid magnocurarine, is toxic in high concentrations. The Chinese, Wilson observed, use it as "a cure for coughs and colds, and as a tonic and stimulant during convalescence."[10] More recently, the Harvard botanist Lily Perry described the drug extracted from the bark as "bitter, pungent, and warming" and said it is prescribed for "flatulence, nausea, lack of appetite, shortness of breath, and dysentery."[11] The dried flower buds, called Yu-po, are used to treat intestinal problems, and are "esteemed as a medicine for women."[12]

Harvesters do not show the same concern for magnolia when removing its bark as they do when harvesting eucommia. In May they cut down twenty-year-old trees and strip the bark from the roots, trunks, and branches. After drying the bark, first in shade and then in sun, the harvesters steam it, roll it into tubes, and sort it according to the part of the tree from which it comes: tube houpo, from the trunk; boot houpo, the irregular remnants of tube houpo; root houpo, also known as "chicken intestine po"; and branch houpo. Since houpo is toxic in large doses, it is never given to pregnant women and always prescribed with other herbs. Herbalists decoct the bark and use the extract in mixtures with rhubarb, licorice, ginger, or other herbs to make teas, powders, and tinctures.

Magnolia officinalis has not performed well in the Arnold Arboretum, but its variety *biloba* has thrived. Not available outside China until 1936, this interesting plant, like eucommia, grows mostly in botanic gardens and arboreta. Seeds obtained by the Arnold Arboretum from the Hangzhou Botanic Garden in 1981 (AA #398–81) have already grown into plants twenty feet tall. Like *M. fraseri* and *M. macrophylla*, both native to North America, its leaves are

arranged in false whorls at the ends of its branches, giving the plant an open, tropical appearance. The combination of these eighteen-inch-long, notched leaves, light gray bark, and large, fragrant flowers make this a striking ornamental tree. Although *M. officinalis* var. *biloba* is not yet used medicinally in North America, its exotic habit and foliage have made it a popular plant for zoo horticulture—curators use it to create tropical exhibits for zoos in temperate climates.

Western chemists have examined both *Eucommia ulmoides* and *Magnolia officinalis* and isolated active compounds from their bark. Tests done at the University of Wisconsin support the claim that duzhong has potential as an antihypertensive drug.[13] Magnocurarine, the alkaloid in houpo has "a neuromuscular blocking effect and cause[s] relaxation of the skeletal muscles."[14] Pharmaceutical companies have not developed these compounds for use in North America because there are already similar drugs on the market.

With a sense of urgency inspired by the rapid disappearance of plant habitats, most researchers are focusing on the diverse flora of the tropics as the source of plant-based medicines. However, as drugs such as taxol and EGb 761 demonstrate, new medicines may also be developed from plants of the temperate regions of the world. Of these regions, China offers the highest floristic diversity and a more than two-thousand-year-old tradition of using plants as medicines. This long history of herbal medicine has already proven valuable to Western medicine and may do so again in the future.

Todd Forrest came to the Arnold Arboretum as an intern in 1994 and now maintains the plant records system for the institution.

Endnotes

[1] F. V. DeFeudis, Ginkgo Biloba *Extract (EGb 761): Pharmacological Activities and Clinical Applications* (Paris: Elsevier Press, 1991)

[2] T. S. Ying, Y. L. Zhang, and D. E. Boufford, *The Endemic Genera of Seed Plants of China* (Beijing: Science Press, 1993), 1.

[3] K C. Huang, *The Pharmacology of Chinese Herbs* (Boca Raton, FL: CRC Press, Inc., 1993), 21–45.

[4] William Watson, "A Hardy Rubber-Yielding Tree," *The Gardener's Chronicle* (1903) 842: 104.

[5] Quoted from *Sheng Nong Ben Cao Chien* by Shiu-ying Hu in "A Contribution to Our Knowledge of Tu-chung—*Eucommia ulmoides*," *American Journal of Chinese Medicine* (1979) 1: 6.

[6] Augustine Henry quoted in William Watson, op. cit. An excellent reference for Henry's travels in China is his own *Notes on Economic Botany of China* (1893; reprint, Kilkenny, Ireland: Boethius Press, 1986).

[7] Dr. Shiu-ying Hu is an invaluable source of information on all Chinese medicinal plants She translated the sections of the *Sheng Nong Ben Cao Chien* dealing with *Eucommia ulmoides* and *Magnolia officinalis* for me and kindly pointed me towards many other sources.

[8] A. Rehder and E. H. Wilson, *Plantae Wilsonianae*, vol I, ed. C. S. Sargent (Cambridge· Harvard University Press, 1913), 433.

[9] *China Plant Red Data Book—Rare and Endangered Plants*, vol. I, ed. L. K. Fu and J. M. Jin (Beijing: Science Press, 1992), 416–417.

[10] Rehder and Wilson, op. cit., 392.

[11] L. M. Perry, *Medicinal Plants of East and Southeast Asia* (Cambridge: MIT Press, 1980), 250.

[12] Rehder and Wilson, op. cit., 392.

[13] Hu, op. cit., 27–28.

[14] Huang, op. cit., 174.