

# Ailanthus

by SHIU YING HU

Ailanthus is called tree of heaven by some people. In its homeland, China, it is known as *Ch'un Shu*, pronounced almost like "train" and "sure" in English. Of all the trees introduced from China into American gardens, ailanthus is the most widely naturalized. The specimens in the Harvard University Herbaria indicate that the species *Ailanthus altissima* (Miller) Swingle runs wild from Massachusetts in the East to Oregon in the West, and from Toronto, Canada in North America to Tucuman, Argentina (and Buenos Aires, by reference) in South America.

In neglected areas of large cities such as Boston, ailanthus grows as trees close to buildings, as hedges, or as bushy aggregates along railroad tracks, highway embankments, walls at the ends of bridges and overpasses, or in cracks of sidewalks and along boundary fences between properties (Figs. 1-2). Around some dwellings the trees are so close to the windows that they prevent light and sunshine from penetrating the rooms, or they send roots to invade the sewers or damage the foundations.

Once ailanthus is established, it becomes very difficult to eradicate, for it can sprout from the stumps and on any portion of a root (Fig. 3, left); moreover, a female tree produces a large amount of winged fruits that spread and germinate in the gardens near, or even far away from, the mother plant. For these reasons, ailanthus has been maligned as a weedy tree by city dwellers. Lately, however, it has attracted the interest of environmentalists, and many of them have asked me questions about the tree both by telephone and in letters. This article contains a summary of the answers to some of the queries. It includes general characteristics of the species *Ailanthus altissima*, a history of its introduction from North China to Europe and thence to America, a review of its early uses in America, my observation of ailanthus in China and its position in Chinese culture, and finally comments on the future of ailanthus as a tree of economic importance in the United States of America.

This article is prepared for the information of the general public; specific material on taxonomy is not included. Phytogeographically the range of the genus *Ailanthus* is primarily Southeastern Asia and the Pacific Islands. *Ailanthus altissima* is the only species that can grow in the temperate or cold temperate regions.

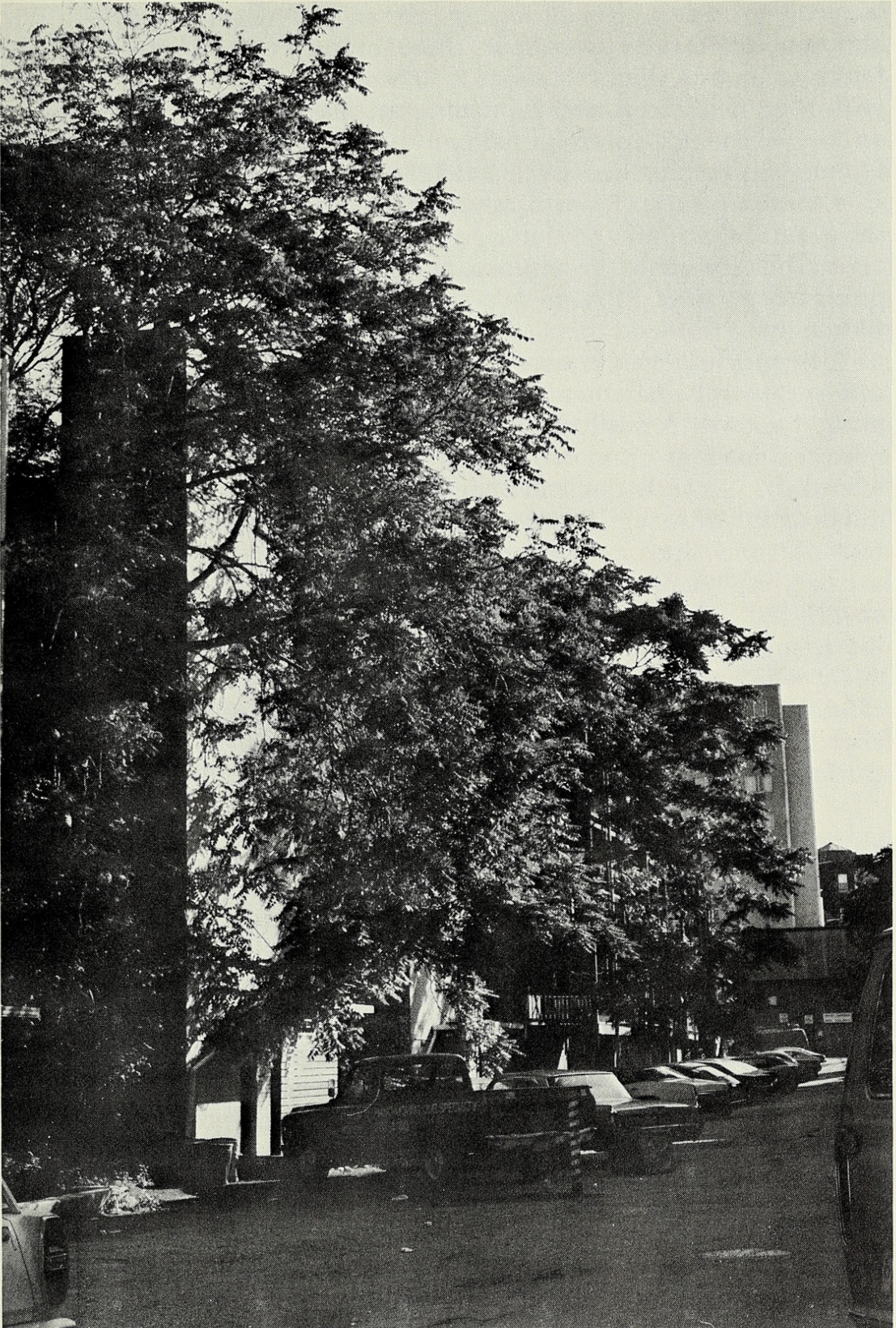
In the transliteration of the Chinese names, the spelling is adopted from the Wade System of romanization as it appeared in Mathew's Chinese-English Dictionary, Harvard University, 1950 edition.

I should like to take this opportunity to express my appreciation to Dr. Lily M. Perry for sharing with me the information in her manuscript on medicinal plants of Asia, to Mr. Walter T. Kittredge for assistance with the illustrations, and to Mrs. Jeanne Wadleigh for many helpful suggestions.

### **Distinguishing Characters of Ailanthus**

In order to have wise use of ailanthus, man must know the plant and be ready to pull the self-sown seedlings and the root sprouts as early as possible. Most people do not use a magnifying lens; without such aid, ailanthus may be recognized by its deciduous habit, smooth light ochraceous-gray trunk, stout branches, and reddish-brown, two- to four-year-old twigs with large heart-shaped leaf scars, each having many bundle scars along the margin and a roundish bud at the sinus. The leaf-bearing twigs are green with very short straight hairs. The leaves of ailanthus are odd-pinnately compound (Figs. 3-7), 20 to 60 cm. long, each with four to thirty-five leaflets. The petioles are terete, enlarged at the base and often tinged red above. The leaflets are ovate-lanceolate, rounded at the base, and each has two to four glandular teeth near the base. The leaves of root sprouts are yellowish-green when first emerging from the soil, and vary in size and number of divisions from unifoliate to trifoliate, pentafoliate, or pinnately compound (Fig. 3, left). The leaves of a seedling are trifoliate, crowded above the two rounded epigeal cotyledons (Fig. 3, right).

The flowers of ailanthus are small, yellowish-green, arranged in large panicles at the ends of new shoots, and they are sexually differentiated. A mature flower bud is roundish and small, about the size of a grain of green foxtail grass seed. The buds are borne on slender pedicels crowded in fascicles arranged on the secondary or tertiary axes, or even on finer divisions of the large panicle (Fig. 4). Normally, a male plant produces three or four times more flowers than a female plant. Naturally the male panicles are much larger than the female ones (Figs. 5-6). During the flowering season, the male flowers are more conspicuous than the female ones, and they emit an odor that attracts numerous insects. A flower of ailanthus has a very tiny cupular and lobed calyx, a corolla with five distinct petals that are hairy on the inside, and an annular and lobed gland. A male flower has spreading functional stamens, each with a globular fertile anther and a glandular cushion-like green disc. A female flower has ten (or rarely five by abortion) sterile stamens (staminodes), each with a heart-shaped abortive anther; a green glandular disc; and a pistil with five coherent carpels, a slender style, and a star-



*Fig. 1. Some self-sown ailanthus back of an apartment house on Commonwealth Avenue between Boston and Brookline, Massachusetts. A solitary tree growing in a limited space of a poorly lighted recess is twice as tall as those growing along the wall with more space and better light. The tall tree (left) has a bole 15 m. high and 45 cm. in diameter at breast height.*

like stigma. Soon after flowering, the carpels develop into five (or, due to abortion sometimes four, three, or even one) separate winged fruits (samaras, Figs. 4 and 6). These samaras mature greenish-yellow or reddish-brown, depending on the varieties. They persist on the branchlets even in winter. During the fruiting season, a female tree is more conspicuous in the landscape than is a male one. Due to the power of root-sprouting in *Ailanthus*, one may find all the plants in an area producing male flowers, while those in another area all bear female flowers and fruit. The male plants of *Ailanthus* do not bear fruit. I have not observed any female plants bearing flowers with fertile anthers. The condition described in most manuals as "polygamous" does not seem to exist in *Ailanthus*.

The general characters given above are for normal plants. Abnormal growth conditions may alter some of the characters. First, repeated cuttings promote vegetative growth and inhibit flowering in *Ailanthus*. Second, abnormal condition of the flowering of *Ailanthus* may occur. This fact is substantiated by a collection of J. C. Nelson (2361) from Oregon. Evidently the specimens were gathered from a dying stump of a female plant. The sprouts are small and impoverished. The leaves have three to five leaflets only, and some of the terminal leaflets are lobed, rather than being divided to the base to form individual leaflets (Fig. 7). The flowers are in solitary fascicles or in small simple cymes in the axils of upper leaves. The abortive stamens are reduced in number, being five only, instead of the normal ten staminodes.

### The Introduction of *Ailanthus* to Europe

*Ailanthus* seed was first carried from Peking to Paris in a trans-continental trip via Siberia in the 1740's. The seed was collected and shipped from Peking by Pierre d'Incarville, a Jesuit priest who joined the China Mission in 1740 at the age of thirty-four. Incarville went to China not only as a mature person, but also as a very learned man who had received a botanical education from Bernard de Jussieu, Superintendent of the Jardin Royal des Plantes, Paris. According to E. Bretschneider, he was a Corresponding Member of the Academy of Science in Paris. He entered China via Macao, and traveled from South China to Peking in North China where he settled and died in 1756.

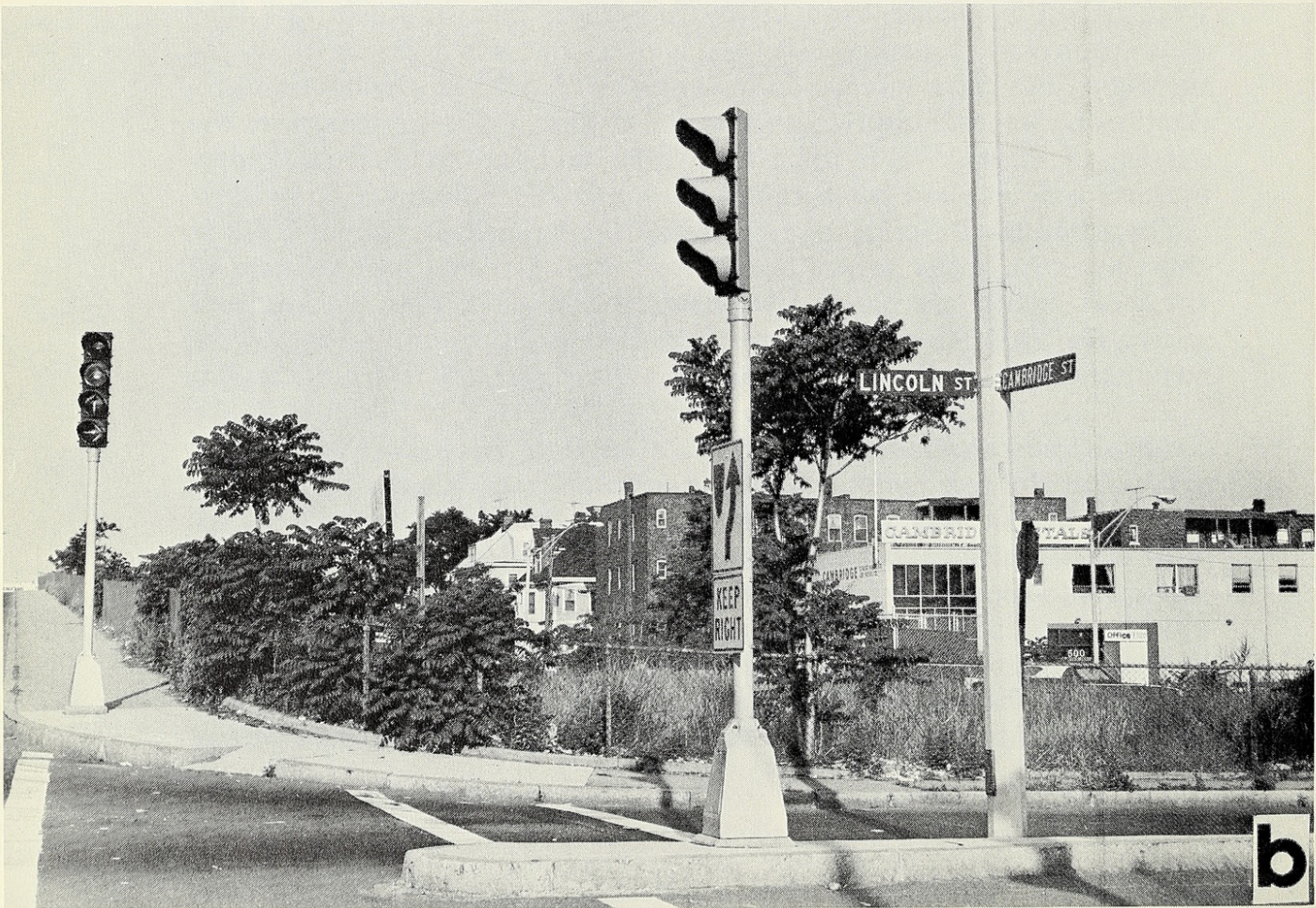
From 1743 onward, Incarville sent herbarium specimens and seeds to Jussieu. *Ailanthus altissima* and *Sophora japonica* are two of his introductions that have become well known in the American landscape. It must be remembered that in the middle eighteenth century, the botanical-minded individuals in Europe were interested in obtaining plants of economic importance in eastern Asia for introduction to their colonies of comparable climate in the Americas. In Incarville's trip from Macao to Peking, he had the opportunity to see the agricultural practices, and to learn about the plants of economic importance

from the subtropical region to the temperate region of China. When he was in the Lower Yangtze Region, he observed the Chinese varnish tree (*Rhus verniciflua*), apparently from a distance. After settling in Peking, he began to study the plants, collect specimens and seeds, and ship them to Paris. On seeing the ailanthus in Peking, he assumed it to be the varnish tree of the Yangtze Region, and sent the seed of ailanthus to Paris with a note about the lacquer tree. Although Incarville was not the first person who mistook ailanthus for a lacquer tree, his note became the source of confusion in the botanical literature in Europe for several decades. Before Incarville arrived in China, many Chinese scholars had recorded the difficulty in distinguishing the lacquer tree from ailanthus; for, as seen from a distance, the light ochraceous-gray trunks and the pinnately compound leaves of the two species are very similar. At the end of the sixteenth century, in *Pên-ts'ao kang-mu* Li recorded an ancient rhyme saying, "Ailanthus, planted or wild; And lacquer tree look alike."

On receiving the seed of ailanthus sent by Incarville, Bernard de Jussieu planted a portion of it in Paris, and sent some to England. Philip Miller, Superintendent of the Physic Garden at Chelsea, and Philip C. Webb, a man with a curious exotic garden in Busbridge, near London, both received some of the seed in 1751. According to W. J. Bean (*Trees and Shrubs Hardy in the British Isles* 1: 197. 1950), Peter Collinson also received some seed in the same year. This lot of seed was viable and produced young healthy trees well adapted for outdoor living in the climate of Paris and London. The seedlings grew beautifully under different names. In Paris they were recorded as *Rhus succedanea* L., or *grand vernis du Japon*; in Chelsea they were called *Toxicodendron altissima* Miller; and in Busbridge they were known as *Rhus Sinense foliis alatis*. Botanical literature of the middle 1750's recorded the dispute on the identity of their new introduction between Philip Miller and John Ellis, Superintendent of the garden of Philip Webb. These records have led to serious nomenclatural problems of *Ailanthus altissima* (Miller) Swingle.

On account of the rapid growth and the beautiful foliage of ailanthus, its popularity soared in Europe, and it soon became one of the most commonly planted and highly esteemed trees in European cities. In 1782, Friedrich Ehrhart visited Holland and saw a good-sized tree in Utrecht, and he named it *Rhus cacodendron* in a report.

In 1785, R. L. Desfontaines became Professor of Botany at the Jardin Royal des Plantes in Paris. Three years later, he observed the samara of the tree called *Rhus succedanea* L. in that garden, and he realized that it was not a sumac. In an article entitled "Mémoire sur un nouveau genre d'arbre, *Ailanthus glandulosa*," he published an illustrated description for the species (Fig. 4). He derived the generic epithet from a Moluccan name, *ailanto*, used by the island people of the Pacific for an evergreen species (*Ailanthus integrifolia* Lamk.) of the tropic forest. To these people, *ailanto* means "a tree of heaven." Desfontaines' name for ailanthus has been accepted widely, and it



appears in European botanical literature as late as 1957. However, by the International Code of Botanical Nomenclature, this epithet has to be disqualified as a valid scientific name for *ailanthus* because it is a later homonym at the species level.

In 1916, Walter T. Swingle, of the United States Department of Plant Industry, studied the history of *ailanthus* in Europe. He transferred to *Ailanthus* an earlier specific epithet given by Philip Miller and made a new combination to supply the correct scientific name for our common *ailanthus*, *A. altissima* (Miller) Swingle. Alfred Rehder in the *Bibliography of Cultivated Trees and Shrubs* listed fourteen synonyms for the species. Readers who are interested in this subject are advised to refer to both Swingle's and Rehder's work.

Genetically *ailanthus* is a polyploid ( $2n = 80$ ). Genetic segregation occurred in cultivation, and in Europe horticultural varieties were recognized in the 1890's. Leopold Dippel in 1892 described three varieties: *A. altissima* a. *rubra*, *A. altissima* b. *pendulifolia*, and *A. altissima* c. *aucubaefolia*. Rehder in 1949 treated the first two taxa as forms.

### ***Ailanthus* in America**

*Ailanthus* came to America via England. William Hamilton of Philadelphia was the first person who introduced *ailanthus* to his garden in 1784. The rapid and luxuriant growth of the plant and its power to thrive in unfavorable situations of poor soil and little care attracted the early settlers. In the 1820's the demand for small trees was handled by Prince and Parsons Nurseries of Flushing, Long Island, New York. *Ailanthus* was gradually planted in industrial centers such as New York City, Brooklyn, Baltimore, and Boston because of its ability to tolerate the dirt and smoke of cities. In the 1840's *ailanthus* was a common stock in the nurseries of eastern United States of America.

The specimens of Harvard University Herbaria and those of the New England Botanical Club bespeak the status of naturalization of *ailanthus* in the New World. As early as 1888, Curtiss reported that *ailanthus* ran wild in Virginia and the neighboring states. Freeman in 1955 reported that in Polk County of North Carolina, *ailanthus* was widespread, forming thickets, and had become a pest in some places. Anderson in 1961 reported that in Missouri, *ailanthus* was the prevailing tree from Kings Highway to the Mississippi River. During a recent trip to New York, I observed that numerous patches of *ailanthus* trees 3 to 7 m. tall occurred on the embankments of the expressway between Boston and New York, especially in the sections within ten to fifteen miles of these two cities. The frequency of the occurrence becomes greater as one nears the cities.

*Elements of Ailanthus in America:* More than one species of *Ailanthus* has been introduced into America. Alfred Rehder in the

Fig. 2. *Ailanthus* growing as weedy trees in the Allston section of Boston. a. A thicket-like stand of male *ailanthus* on a dump adjacent to a railroad at the junction of the Massachusetts Turnpike and Western Avenue, with tenaments in the background; b. *Ailanthus* growing along a fence on Western Avenue where it passes over the Massachusetts Turnpike. The trees that have been cut repeatedly appear bushy.

second edition of the *Manual of Cultivated Trees and Shrubs Hardy in North America* included two species and three horticultural varieties of *Ailanthus*. The species are *A. altissima*, which is recognized by its smooth twigs and smaller fruits measuring 3 to 4 cm. in length; and *A. vilmoriniana*, which is distinguished by its prickly twigs and larger fruits measuring 5 to 5.5 cm. in length. The common ailanthus in cities and the naturalized trees all belong to *A. altissima*. In the Boston area this species has two forms; namely, *A. altissima* f. *altissima* with greenish-yellow fruits, and *A. altissima* f. *erythrocarpa* with reddish-yellow fruits.

*Objections to Planting Ailanthus:* In American horticultural literature, one may find several objections to using ailanthus for ornamental purposes. First, from the aesthetic point of view, some people dislike the massive clusters of shaggy fruits that remain on the leafless twigs in winter. Moreover, the self-sown plants often grow in unwanted places, and they are frequently harmful to neighboring objects such as living plants or constructions.

Second, to some people ailanthus is a generator of unpleasant odors because the leaves produce a foul smell when crushed. For this reason, the tree of heaven has been called the "stink tree." During the flowering season, the male trees emit an odor that is disagreeable to some people; near the flowers, it is barely detectable.

Third, there are charges that ailanthus is poisonous, and it is blamed for catarrhal troubles. Two cases of ailanthus poisoning were reported in *Garden and Forest*. The first case was reported by C. V. Tice in 1888. It concerned ailanthus fever contracted by a man in Boonsboro, Maryland, who suffered from sore throat, nausea, and inability to sleep at night for three weeks. The second case, reported by A. H. Curtiss, referred to a contact poison. A man cut down an ailanthus tree by trimming off the branches first; by night, his hands and face began to swell and his eyes were swollen shut. He suffered severely for several days. As no other cases were known, the editor of the journal commented that these criticisms of ailanthus were unfair. The man might have cut a poison sumac and misidentified it as an ailanthus, for without fruits as a guide, it would be difficult for a lay person to distinguish the two species.

*Afforestation with Ailanthus:* At first ailanthus was planted in America exclusively for ornamental purposes. Later it was used in some states for afforestation. Charles Sargent, the founder and first director of the Arnold Arboretum, was an advocate of this latter use. In the first issue of *Garden and Forest* he explained the merits of ailanthus, saying, ". . . for hardiness and rapidity of growth, for the power to adapt to the dirt and smoke, the dust and drought of cities, for the ability to thrive in the poorest soil, for beauty and for usefulness, this tree is one of the most useful which can be grown in this climate . . ." (*Gard. & For.* 1888: 380). Regarding the economic value of ailanthus, he pointed out that the species is a good source of



Fig. 3. Young ailanthus. Left: Sprouts from a rootlet 2 mm. in diameter. This rootlet is 5 m. away from the trunk of the mother plant. It emerges from a root extending from the base of the trunk to an island between the sidewalk and the street, sending branches upward to 2 cm. near the surface of the ground, and then produces three sprouts on a section 2 cm. long. The oldest sprout is nearer to the mother plant; the second one appears to have originated from a spot opposite the oldest sprout. The one on the right is the youngest. Apparently, soon after the sprouts could carry on the function of photosynthesis with their immature leaves, food material was stored in the cortex of that portion of the root between the three sprouts. Here the root is twice as thick as the sections before and after the emergence of sprouts. Photo: W. T. Kittredge.

firewood that has comparable heat-producing properties to those of white oak, black walnut, or birch. It burns steadily and slowly, giving a clear bright flame, leaving a good bed of coals, and finishing with a small amount of ash. For furniture, Sargent noted that the wood is "heavy, strong, it neither shrinks nor warps in seasoning . . . as material for cabinetmakers it has few superiors among woods grown in the temperate region. . . ."

Charles Koffer in 1895 reported that ailanthus was recommended almost without qualification for afforestation in Kansas. However, the species has proved to be unable to withstand the prolonged dry seasons on the high land in the Middle West. He also stated that ailanthus is profitable for the supply of fuel obtained when the trees are cut to the ground every few years, ". . . but in close plantation

it can hardly be grown as a timber-tree. . . . The species is too tender for northern Nebraska and the Dakotas. . . ." (*Gard. & For.* 8: 122-123).

In 1926 Illick and Brouse reported on the experiments of afforestation with ailanthus in Pennsylvania. They observed that as a forest tree, ailanthus is a fast grower, a persistent sprouter, and an aggressive competitor with the native species. The one-year-old seedling grows 1 to 2 meters tall; strong shoots sprout not only from the stumps, but also from any portion of the root; and the large amount of seed produced annually by mature trees and blown to the neighboring woods germinates. The progeny is difficult to eradicate. In this respect it is worthwhile to mention a report made in 1959 by François Mergen, of the School of Forestry, Yale University. Mergen found that an aqueous extract of ailanthus leaves contains a principle that is toxic to thirty-five species of gymnosperms including twenty-one pines, six spruces, five firs, a larch, a Douglas fir, and an arbor-vitae. Of the eleven species of native broad-leaved trees subjected to the experiment, only the white ash (*Fraxinus americanus* L.) was not affected adversely. Mergen suggested that a toxic leachate from the cuticular excretion of ailanthus leaves washed off by rain, produces a depressing effect on the growth of the neighboring plants.

Regarding the economic value of the product, Illick and Brouse reported that the fast-growing young ailanthus produces inferior wood that is brittle, non-durable, and easily split. The wood of old trees is comparable to that of ash or chestnut; it is moderately heavy, rather durable, difficult to split, and has a beautiful lustre. The sapwood is white-yellow, and the heartwood is grayish-orange. It does not shrink or warp in drying, and can be used for cabinet work, musical instruments, woodware, and charcoal. These authors further explored the possibility of making pulpwood of ailanthus and reported the findings of the Forest Products Laboratory of the USDA in Madison, Wisconsin. According to this report, the wood is well adapted for pulp, superior to the woods then used extensively in the United States for the purpose. The paper prepared from ailanthus pulpwood is good for books, lithography, and other purposes that require softness and opacity. It was noted that the wood of ailanthus must be harvested before the trees are thirty years old. As the plants grow to full size, they begin to deteriorate. The brittle branches break in strong winds and heavy snow, leaving deformed crowns. Moreover, a heart rot starts, and the trunk gradually becomes hollow. Then the tree falls in a storm.

### **Ailanthus in China**

Ailanthus has a different appearance in its homeland, China. As far as I know, there ailanthus appears neither bushy nor weedy. It rarely occurs within the city limits, but grows in villages or in the suburbs as isolated trees with straight, tall boles and rather flat

crowns. One may wonder why it is that the same species of tree behaves so differently in the two countries, China and the United States. The answer is an ethnobotanical one. The shape of a tree depends largely upon the man around it. In American cities where the self-sown plants of ailanthus are cut to the ground periodically by the workmen of the park department, they become bushy because of their ability to sprout from the stumps. In the neglected areas, the root sprouts of the established trees and their seeds develop into pure stands of thicket-like aggregations, partially because of the toxic leachate from the leaves that prevents the growth of other species. In China the situation is different. China is a densely populated country. As I have observed, fifty years ago nearly 90 percent of the population cooked with plant material, which included wood, straw, leaves of deciduous trees in North China, and dry manure of cattle in the nomadic areas. Under such conditions, children as well as adults gathered whatever combustible material they could obtain for fuel. No trees had a chance to grow unless they were wanted and protected by the owners. The wanted trees grown under protection were given proper care. Their lower branches were pruned at the proper time and the boles thus became straight until they were 15 or more meters tall. The unwanted self-sown young trees were exterminated by fuel gatherers. It is true that in comparison with the wood of a mature ailanthus tree, the heat-producing power of young trees and root sprouts is poor, yet they can provide a fuel better than leaves and straw.

*The Cultural Aspect of Ailanthus in China:* In China the history of *Ailanthus* is as old as the written language of the country. In *Êrh-ya*, the first encyclopedia on the natural history and cultural objects in China, ailanthus appeared as the second name in a list of trees. Apparently the name used by the prehistorical ethnic groups existed in sound long before the development of writing. During the formative period of the written language of China, four ideograms with slightly varied pronunciations were created for ailanthus and recorded in the literature written before 100 B.C. In a *Materia Medica* compiled by imperial order in 656 A.D. (T'ang Dynasty) an ideogram consisting of the *mu* (wood) radical on the left and a *ch'un* (spring) sound on the right appeared in a pair with the *Êrh-ya* ideogram. Since then, in Chinese botanical literature these two ideograms have been applied to ailanthus either together, or individually with one being listed as the synonym of the other. In the two most widely used botanical references, the authors did not agree in their choice of the ideograms. In 1937, Professor Chen in the *Illustrated Manual of Chinese Trees and Shrubs* chose the older *Êrh-ya* ideogram for the genus *Ailanthus*. In the more recent work, *Iconographia Cormophytorum Sinicorum* (2: 561. 1970), published by the Science Press in Peking, the T'ang ideogram is chosen with a modifier. In this work *Ailanthus altissima* is called *ch'ou ch'un*



Fig. 4 (left). The first illustration of ailanthus with flowers and fruits (from Desfontaines, 1788.) Photo: W. T. Kittredge.

Fig. 5 (right). A specimen of ailanthus with a male panicle (E. E. Stanford 1488, California, May 16, 1930, Gray Herbarium.) Photo: W. T. Kittredge.

(stinking ch'un). The vernacular name in the Lower Yellow River Region for ailanthus is *ch'un-shu* (spring tree), a heritage the people received verbally from their ancestors since time immemorial.

There is an ethnobotanical reason why the prehistorical people of the Lower Yellow River Region called ailanthus the "spring tree" (*ch'un-shu*). It was not because they could detect the first sign of spring by the revival of life activities in ailanthus; it was an expression of release from severe cold and starvation. They observed that among all the deciduous trees of the area, ailanthus had the longest winter dormancy. They noticed that in the spring it remained leafless while the cottony seeds of willows were flying in the air, the coinlike samaras of the elms began to fall to the ground, and the food supply dwindled. To the people suffering from cold and starvation in semihibernation, the enlarged buds of ailanthus were an assurance of the return of the warm weather and a sign of hope for the approach of the next harvest season. Seeing the unfolding buds, the early people of North China exclaimed, "Oh, Spring is finally here!" That the rural people of North China link the enlarged buds of ailanthus with starvation is manifested in a nursery rhyme, "*ch'un-shu mao tsuan, o-ti ch'ung-jên fan po yen*" — "As the unfolding buds of ailanthus appear, the helpless white eyes of the starving people turn clear."

In Chinese botanical and pharmaceutical literature, *ch'un* is the basis of the common names of two trees. In addition to *ch'un-shu* for

ailanthus, it is also used for another species that resembles ailanthus in the pinnately compound leaves and in the delayed resumption of life activities in the spring. This species is *Toona sinensis* (A. Juss.) Roemer (better known in the United States as *Cedrela sinensis* A. Juss.). In North China, ailanthus grows spontaneously while cedrela is cultivated for its aromatic edible young shoots, used primarily as a spice. When the odors of the two species are compared, cedrela is called *hsiang-ch'un* (fragrant spring tree) and ailanthus is known as *ch'un-shu* in the villages, and *ch'ou ch'un* (stinking spring tree) in cities. In Li's *Pên-ts'ao kang-mu* and in some other Chinese Materia Medica published after this work, *hsiang-ch'un* and *ch'un* are discussed together, for both the leaves and the bark of the species are used in traditional Chinese medicine. Practitioners in China distinguish the products of the two species by smell and color. Accordingly, the products of *hsiang ch'un* smell pleasant and the bark appears dark brown with a reddish tint. In the market this bark is called *Hung-ch'un-p'i* (bark of red ch'un). The products of ailanthus smell foul, and the bark appears ochraceous-gray. The market product of ailanthus is called *ch'un-po-p'i* (white bark of ch'un).

In the literature of the Chinese people, ailanthus is expressed in two extreme metaphors: a mature tree refers to father, and a stump sprout indicates a spoiled youth. In writing letters between friends, *ch'un* (ailanthus) and *hsuan* (daylily) represent parents. When one expresses best wishes to a friend's father and mother in a letter, one writes *ch'un-hsüan ping-mou*, which may be translated literally as wishing that both your ailanthus and daylily are strong and happy. Ailanthus is chosen to represent the father for its magisterial posture as expressed by the straight, tall bole in a mature tree; daylily is used to refer to the mother because of the comforting and strengthening effect of mother love comparable to the function of *Hemerocallis* as a medicine, which "... benefits the mind and strengthens the will power, gives happiness, reduces worry . . ." (*Am. Hort. Mag.* 47(2): 53. 1968). When a disappointed father scolds a spoiled son, or a critical teacher writes about an irresponsible youth, he uses *ch'un-ts'ai*, which means literally "the good-for-nothing ailanthus stump sprout." Ailanthus stump sprout is used as a metaphor for a youth who is not bound to obligations. This is due to the writings of Chuang-tsu, a Taoist philosopher and writer of 300 B.C. who described a large tree with a crooked, enlarged base that produced wood unsuitable for the rulers and compasses of carpentry. Ancient scholars after him interpreted this to refer to ailanthus, and used it as a metaphor for delinquent youths who follow no rules and customs. They believed that a youth with such a beginning in life, like stump sprouts of ailanthus, will not develop into a useful mature person.

*The Economic Aspects of Ailanthus in China:* Ailanthus is grown in China for its wood, leaves, and the bark from root and stem.

#### 1. The Use of Ailanthus Wood: The Lower Yellow River Region

has been a cradle of Chinese civilization and the seat of ancient Chinese history. There is hardly any natural vegetation left in this area, and few species of wood-producing trees. The common species are *Ailanthus altissima*, *Melia azedarach*, *Morus alba*, *Populus cathayana*, *P. tomentosa*, *Pyrus betulaefolia*, *Salix babylonica*, *Sophora japonica*, *Ulmus pumila*, and *U. parvifolia*. Among these species, *Ailanthus altissima* and *Sophora japonica* are the best producers of useful wood for all purposes. The rural people have a saying that the quality of the wood of an old ailanthus tree is comparable to that of *Sophora japonica*. In regard to the character of ailanthus wood, Y. Chen in the *Silviculture of Chinese Trees* (1933) reported that the wood is yellowish-white, lustrous, moderately hard, difficult to split, and has good flexibility. It is best fitted for the manufacture of steamers. (A steamer is a useful kitchen utensil essential for all types of Chinese cooking. The northern people depend upon it for steaming bread; and the southern people, for rice and various pastries. The sizes of steamers vary from 10 to 150 cm. in diameter, and the height has similar variations.) According to Y. Chen, Changhsin District (Long. 119°57' E, Lat. 31° N) in Chekiang Province of East China is famous for the production of steamer board from cultivated ailanthus.

2. The Use of Ailanthus Root for Mental Illness: This is one of the oldest recipes, first recorded in a *Materia Medica* published in 731 A.D. In those days, a psychologically unbalanced person was thought to be possessed by the demon. For a mentally dissociated person, gather a handful of fresh root. Cut the material into small pieces, and put it into 2 litres of urine gathered from young boys. Add 100 centilitres of *tou-shih* (material prepared from black soybean; cooked, fermented, salted, and treated with several herbal medicines; used as a health food and a spice, available in Chinese groceries in large American cities). Let the mixture stand overnight. Then press the liquid out, and bring it to a boil. Divide the liquid into three to five portions, and serve the patient one portion each day.

3. The Use of Ailanthus Leaves: In Chinese literature, reports were available on the use of ailanthus leaves for the silk industry in Shantung Province, and for medicine since the T'ang Dynasty.

For the production of Shantung or pongee silk, Y. Chen in 1933 gave this data. In Shantung Peninsula, particularly in Yen-tai (also known as Cheefoo, Long. 121°25' E, Lat. 37°30' N), ailanthus is cultivated for feeding the worms of a special kind of moth (*Attacus cynthia* Drury) for the production of "Shantung silk." This insect produces a kind of small ellipsoid cocoon pointed at both ends. The silk obtained from the unwound cocoons is coarse and durable. It does not take dye, and the fabric in natural color is commercially known as Shantung silk or pongee silk. The moth is big, grayish, with deeper color near the base of the wings, and with a crescent transparent spot and some reddish patches in the center of each wing. Professor C. E. Wood, Jr., of the Arnold Arboretum, has in-



Fig. 6 (left). A specimen of *ailanthus* showing a female panicle with a portion of young fruits added (A. H. Curtis), Virginia, June 1871, Gray Herbarium. Photo: W. T. Kittredge.



Fig. 7 (right). An abnormal condition of flowering in *ailanthus*, showing two sprouts from an impoverished stump with small fascicles or simple cymes of female flowers (J. C. Nelson 2361, Oregon, July 1918, Gray Herbarium). Photo: W. T. Kittredge.

formed me that, like *ailanthus*, the Shantung silk moth has been introduced into the United States and is naturalized in America.

*Ailanthus* leaf is also a Chinese herbal medicine. Li in *Pên-ts'ao kang-mu* summarized the history of its use and reported the properties accredited to the material. According to a *Materia Medica* compiled in T'ang Dynasty (ca. 684 A.D.), the leaves are slightly poisonous. When taken internally, they affect the nervous system, making a person sleepy and incoherent, with slow breath and weak pulse. For external uses, they are boiled in water to make a wash to cure skin ailments, especially boils, itches, and abscesses.

Li recorded a very interesting recipe for baldness. The tender young leaves of *ailanthus*, catalpa, and peach are pounded together. The juice squeezed off the crushed material is smeared over the bald area to stimulate hair growth.

4. The Use of *Ailanthus* Bark in Medicine: The dried bark of *Ailanthus altissima* is an officinal drug called *ch'un-po-p'i* (white bark of ch'un) (Fig. 8). The market product in drug stores consists of the barks of the root and the stem. In the new Chinese *Materia Medica* (*Chung Yao Chih* 3: 459-463. 1960), there is an illustrated account of the botanical description, centers of production, preparation, identification of the market product, medicinal properties,

chemical constituents, and pharmaceutical uses. Readers are advised to consult this reference for details. An abstract of the preparation of the drug, the appearance of the market product, and the chemical constituents is given here.

The tree is felled in spring or autumn when the bark has the highest amount of stored material. The bark is stripped, and the outer rough portion of each piece is scraped. It is then dried in the sun for the market. In retail drug shops, the dried bark is softened by briefly soaking it in water, then it is drained and covered in a basket to let the moisture permeate the interior. The softened pieces are sliced. The slices are dried and kept in a container for filling prescriptions. In traditional Chinese medicine, roasted *ch'un-po-p'i* may be called for. Such material is prepared by heating bran in a pan until it begins to smoke. The sliced or shredded bark is added to the hot bran and turned thoroughly. The mixture is taken off the pan and the bran sieved off; then it is cooled and kept for use.

In the market, the root bark appears like a piece of tile, flat or incurved, sometimes rolled into tubes, yellowish-brown, and tough. The sizes of the pieces are 3 to 10 cm. long, 1 to 5 cm. wide, 5 to 10 mm. thick; they are rough on the outside, smoother on the inside which is marked with punctiform or linear short elevations; the taste is bitter. The bark of the stem appears grayish ochraceous, irregular, and thicker than the root bark. The pieces are 1.5 to 2 cm. thick, and other characteristics are similar to those of the root bark (Fig. 8).

Practitioners of traditional Chinese medicine credit ailanthus bark with cooling and astringent properties, and regard it as beneficial for eliminating the physiological condition termed "damp-heat." It is prescribed primarily for dysentery, intestinal hemorrhage, menorrhagia, and spermatorrhea. The amount used in each prescription is relatively small, varying from 4.5 to 10 g. Patients without the symptoms of damp-heat, and those with stoppage in the excretory systems must not take ailanthus bark.

Li in *Pên-ts'ao kang-mu* recorded eighteen recipes with ailanthus bark for medicinal purposes. A few samples are selected and translated here. In the translation, the conversion of the ancient measurements of volume and weight was made with use of *A New English-Chinese Dictionary* published in 1975 by the Joint Publishing Company in Hong Kong.

For a mother who suffers from prolapse of the rectum after childbirth, put a handful of roasted bark of the branches of ailanthus in five litres of water and add five scallions with roots and a pinch of Szechuan pepper (*Zanthoxylon simulans*). Boil the mixture down to three-fifths of the original volume. Pour the liquid into a pan through a sieve and use it while hot to wash the troubled area. The liquid is good for five washes. It can be heated after it turns cold. The patient should lie down and rest after each wash.



Fig. 8. Commercial products of *ailanthus* purchased from a drug store. The outer surface of the stem bark (top); root bark (lower left); inner surface of stem bark (lower right). From Chung Yüeh Chih photo 159, copied by W. T. Kittredge.

Almost 80% of the recipes Li recorded are for intestinal ailments. For a child suffering from diarrhea, pound *ailanthus* bark into fine powder, and mix with the soft portion (mesocarp) of the fruit of jujube (*Zizyphus jujuba*; a health food, available in Chinese groceries in America). Make balls of the size of a hazelnut, and expose them to the sun. Crush down the balls and mix the material thoroughly. Roll it into balls and expose them to the sun as before. Repeat the procedure three times. Feed the child seven pieces on an empty stomach. The diarrhea will be cured before he finishes seven doses.

For an adult who suffers from intermittent dysentery caused by *Entamoeba histolytica*, pulverize equal amounts by weight of *ailanthus* bark and the seed of myrobalan (*Terminala chebula*) with thirty cloves (*Syzygium aromaticum*). Make pea-sized pills with vinegar; take fifty pills each time with rice water.

For intestinal hemorrhage that lasts for months, use 6 g. of *ailanthus* bark and a cup of water. Boil the material until seven-tenths of the liquid is left in the container. Add one-fourth of a cup of gin and drink the mixture warm. If the patient is very weak, boil

the bark with 6 g. of ginseng and take the liquid mixed with gin in a similar manner.

The researches of phytochemists and pharmacologists in Asia and Europe have thrown some light on the scientific justification of the medicinal uses of the bark of ailanthus. An alphabetical list of chemical constituents isolated from ailanthus is given here: ailanthin, calcium oxalate crystals, ceryl alcohol, fatty acid, glyceryl trioleate, invert sugar, isoquercetin, mucilage, oleoresins, quassin, saponin, stearic acid, sterols, tannin.

5. The Use of Ailanthus Fruit in Medicine: The samaras of ailanthus are called *Feng yen ts'ao* (herbal phoenix eye) in the Chinese drug business. It is used as a hemostatic, for blood in the feces and urine, and for spermatorrhea. Recent clinical experiments proved its efficacy in the cure of trichomoniasis, a vaginal infection caused by *Trichomonas vaginalis*.

### Future of Ailanthus

The jigsaw pieces of information extracted from accumulated literature reveal the role of ailanthus in Asia, Europe, and America and provide us with some guidelines to evaluate it with respect to the welfare of mankind in the future.

In America, ailanthus has been grown for nearly two hundred years; first with enthusiastic praise, and then in undue neglect. Under such abnormal conditions, ailanthus has failed to offer the American people its best qualities. At one time, ailanthus was planted widely, sometimes in areas where it did not have the capacity to thrive. It failed in the afforestation of the plateaus and the high plains of the Great Plains region in the United States. By neglect it spread without check and became weedy in cities of the less dry areas of America. In 1961, Edgar Anderson used the phrase "Ailanthus . . . a blessing and a curse." It is true that through wise use ailanthus can be a blessing to the people, and by neglect it can be a curse. If American people want to have the benefit of ailanthus, they must be aware of its merits and shortcomings. Disciplined, ailanthus should be allowed to grow for it has much to contribute to the American people in our jet age.

*Ailanthus for Air Renewal:* Ailanthus is a tree with large compound leaves. The divided leaf blades provide the largest possible surface area for effective photosynthesis with oxygen as a by-product released into the atmosphere. American people need trees for the renewal of the air more than ever before, for the per-minute consumption of oxygen by cars and airplanes is hundreds to thousands of times more than such consumption by people. At a time when man has learned that trees are the most effective green plants for air renewal, wise use of ailanthus must be promoted.

*Ailanthus as an Energy Supply:* In an age when mankind everywhere is becoming increasingly concerned over the shortage of energy, people should take a fresh look at ailanthus. Its luxuriant, feathered foliage provides an effective agent for capturing the radiant energy of the sun and transforming it into chemical energy in the form of cellulose and other organic compounds. Its capacity for fast growth furnishes adequate space for storing this energy. The young plants grow unusually fast in height, and the older ones increase noticeably in girth. A thirty-year-old tree has a bole 10–15 meters high and a girth of 30–35 cm. in diameter at breast height; thus, the trunk and large branches are excellent organs for the storage of the chemical energy. They provide good sources of charcoal and firewood for supplementary house heating. Ailanthus should be considered equally with birch, white oak, and other species offering comparable heat-producing properties.

*Ailanthus for Clothing and Food:* The people of Shantung have demonstrated that ailanthus can be a source for the silk industry. Although the area of production of Shantung silk or pongee and the number of people involved in the industry are relatively limited, the product has a worldwide reputation. Before World War II, Shantung silk was available in large cities in Asia, America, and Europe. In Boston, members of the older generation praise it as a material for clothes and curtains. Fifty or sixty years ago, soybeans, like Shantung silk, were well-known products of China. Now, soybeans have become important products in the American economy and are exported from the United States. Many American soybean products are unfamiliar to the Chinese people. In the case of the soybean, the application of scientific principles in agriculture and the development of technology in America made the difference. Some investigators may find reward in research into the potentials of ailanthus as a source of silk for clothing and other domestic uses.

In 1944, Ronald Melville of the Royal Botanic Gardens, Kew, published an article on ailanthus as a source of honey. The owner of a Kensington apiary, A. Chesnikov, sent him a sample of honey for examination. It appeared pale greenish-brown and had a peculiar flavor that tasted like a mild floral bouquet with an aftertaste of "cats." On analysis, Melville found that the pollen constituents were 44% ailanthus, 26% chestnut, and 6% each of *Ligustrum* and *Tilia*. After the honey stood for a few months, the unfavorable taste disappeared, perhaps due to oxidative change, and the honey had a "delicious rich muscatel flavor." In 1945, C. Elton reported that on July 14, 1944, he observed thousands of hive-bees (*Apis mellifica*) visiting the male flowers of ailanthus at dawn. He saw no flies on the tree, "commonly associated with fly-pollinated flowers." Ailanthus can be a source of nature food, but the product must be kept for some time to let the flavor mature.

*Ailanthus and Industrial Potentials:* The Forest Products Laboratories of the United States Department of Agriculture have records on the physical properties of ailanthus wood pulp for the paper industry. The wood of mature ailanthus trees is of proven quality for cabinet work, musical instruments, and other types of wooden ware. Presently there is a need of breaking through the habit of using only certain woods, and the creation of market demand for the products made of ailanthus wood.

Like ailanthus, paulownia was introduced into eastern America for ornamental purposes. Its popularity vanished gradually and meanwhile it also became naturalized in eastern North America. Ten years after the publication of my monograph of paulownia, I heard from an Argentinian forester, Hector R. Mangieri, who had the vision of using paulownias for afforestation in that country. He put scientific principles into practice and prepared furniture and other articles for exhibition in the VII International Forestry Congress which took place in Argentina. Now, South American countries supply paulownia wood to Japan. In the United States, as in the case of paulownia, there are not enough large mature trees to supply any demand for ailanthus wood. In order to meet any future need of the wood, present planting of ailanthus is urgent.

*Ailanthus for Medicine:* An increasing impact of traditional Chinese medicine and pharmacy has been felt in the American medical profession and the pharmacological community. In the past few years, the Chinese Acupuncture Association, the American Center for Chinese Medicine, and the Institute for Advanced Research in Asian Science and Medicine (IARASM) have been organized in New York City and in Washington, D.C. In a recent letter from the Director of IARASM, I learned that the Institute is interested especially in information regarding Chinese medicine used as antihypertensive, antipsychotic, antihemorrhagic, antihyperglycemic, antibacterial, and anti-inflammatory agents. In traditional Chinese medicine, we have seen that ailanthus roots and leaves are used as antipsychotic agents, and in the treatment of dysentery and intestinal bleeding; ailanthus bark and fruits are used for antihemorrhagic, antibacterial, antiparasitic, and anti-inflammatory purposes. Unlike ginseng and many other adaptogenic Chinese herbal medicines which are used for keeping the body healthy and fit to fight the attack of disease germs, ailanthus leaves, roots, fruits, and bark are used for curative purposes. In comparison with other agents, the advantage of ailanthus is that the supplies can be obtained readily in large quantity and at reasonable price. There seems to be an open field for investigation in this area.

## Conclusion

In the struggle for survival with natural forces, the ancient people in the homeland of ailanthus have used it to meet their essential

needs for the construction of their primitive shelters and simple furniture, for a source of energy in cooking and heating, for the conservation of their mental health, and in the treatment of their physical ailments, particularly as a cure for various types of dysentery and intestinal hemorrhage. The species was first introduced to Paris under the assumption that it was the varnish tree. For almost thirty-five years, ailanthus was cultivated in Europe as a species of *Rhus*. There it was praised for its beautiful foliage and hardiness, and was used as a street tree.

Ailanthus was introduced from England to Philadelphia in 1784, and its popularity soared in the nineteenth century in America where it was widely planted for landscape purposes, especially in the industrialized cities in eastern United States. It was praised for its "power to adapt to the dirt and smoke, the dust and drought of cities." Now ailanthus is naturalized widely in the United States, and by neglect, it has become a weedy tree in cities, and even a pest in some areas. Many of our other street trees are weedy. The maples, horsechestnuts, elms, and ashes are the most obvious. We need trees in our landscape, and cannot abandon them merely because they scatter fruits or seeds that germinate freely in unwanted places such as our gardens and yards. At a time when man plants trees not only for ornamental purposes, but also for clean healthy air, for the transformation of the radiant energy of the sun into chemical energy stored in plants, for industrial raw material, and for natural drugs without harmful side effects, ailanthus deserves a new look; obviously, it has the potential to be effective in all these areas. Future investigations in ailanthus must be established on the foundation of past experiences and accumulated knowledge of the species. May the readers find the necessary foundation in this article, and more help in the bibliography listed below.

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