MALUS

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INTERNATIONAL ORNAMENTAL CRABAPPLE SOCIETY

OFFICERS

SOCIETY COMMITTEES

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INTERNATIONAL ORNAMENTAL CRABAPPLE SOCIETY BULLETIN

Spring 1994 **Volume 8, Number 1**

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LETTER TO THE EDITOR

Dear Editor:

I lost part of my collection of gardening books to thieves that broke into my house. I want to replace the following books: 'Crabapples for America' by Donald Wyman, both the 1943 and 1955 editions and the book by the American Assn. of Nurseryman entitled 'Ornamental Crabapples' by A. F. den Boer. Would you have spare copies of these or be able to help me locate them?

Roger R. Nelson
Iris Country
6219 Topaz Street NE
Brooks OR 97305

If anyone can help, please contact Mr. Nelson directly. Ed.

JOHN A. CLUSEN

On October 15, 1993, our Society lost a long-term member when John A. Clusen, a volunteer at the Morton Arboretum, died of a heart attack at age 74.

John was already involved in the Arboretum's crabapple program when the Society was formed. He willingly assisted in many of the tasks that had to be done to help the Society - tasks ranging from stuffing envelopes to packing and shipping trees for the National Crabapple Evaluation Program (NCEP). He also helped survey and map the Arboretum's crabapple plantings, and to care for the young trees. Eventually, he became experienced in evaluating the different varieties, and occasionally accompanied Dr. Tom Green on evaluation trips to nearby arboreta. John also helped compile and tabulate results received from all NCEP participants. John died at the Arboretum at noontime after guiding a morning tour. Thus he completed his life doing what he liked best at a place he loved.

THE USE OF CRABAPPLES AS POLLINIZERS IN APPLE PRODUCTION

Julianna Gothard
Pullman Washington

Crabapples are used for ornamental purposes in the landscape. They are valued for their flowers, growth habit, foliage, and fruit. Crabapples are also used as pollinizers in apple orchards and offer certain advantages to growers.

The crabapple produces a large amount of pollen that is good for pollinating commercial apple cultivars. There is another economic advantage to using crabapples as apple pollinizers; they occupy much less space in the orchard than do apple cultivars used for pollination. Single variety orchards with crabapple pollinizers can be planted with the advantage of uniform pest and disease control and mechanization of harvesting.

The characteristics of a good pollinizing crabapple are: 1) small fruits; 2) virus tolerance; 3) profuse, annual blooming with heavy pollen shedding; 4) diploidy; 5) good pollen germination; 6) a bloom period that overlaps the bloom period of the commercial apple cultivars; and 7) fire blight resistance. Other important characteristics in selecting crabapple cultivars as pollinizers are: 1) attractiveness to the bees; 2) no production of fruit that requires extra care; and 3) profuse bloom every year on one-year-old wood. Bees must work both the crabapple flowers and the white apple flowers. Never use red flowering cultivars because bees are red blind, and therefore they won't see these flowers. For this reason crabapple cultivars with white flowers will attract bees to both the apple and crabapple flowers most efficiently.

The crabapple pollinizer also should produce small fruits so the grower won't expend effort harvesting them. After fruit set, chemical thinners can be used to abort the crabapple fruit. Thus the crabapple tree uses its photo-assimilates to produce more new shoots for abundant flowers in the following year.

The crabapple cultivar has to be diploid, with two sets of chromosomes, so that the pollen will be viable, and fertilization will be successful. The pollen of the crabapple flower should have a high percentage of pollen germination for producing a large fruit set. The bloom period of the crabapple must overlap the bloom period of the main variety for the best pollination.

The crabapple should be resistant to fire blight which is a bacterial disease caused by the bacterium, *Erwinia amylovora*. Fire blight damages the plant by killing the flowers and the twigs, and by girdling large branches and trunks that can lead to the eventual death of the tree. Young trees can be killed to the ground by a single infection in one season.

The best cultivars of crabapples for apple pollination in England are 'Golden Hornet', 'Profusion', 'Hillieri', and 'Aldenhamensis'. These cultivars, however, have not been successful in the U.S. Sixty-seven crabapple cultivars were evaluated in New York, at Geneva, and only three were acceptable as good apple pollinizers. These three cultivars were 'Rosedale', 'Pioneer Scarlet', and 'Manchurian' ('Manchurian' is used in Alabama, Ed.). Other pollinizers recommended for apple pollinizers are 'Chestnut', 'Snowdrift', and 'Pearleaf'. The characteristics of these recommended crabapple pollinizers are shown in Tables I, II, & III.

Three different pollinizers should be used in an orchard in order to have crabapple flowers available for the bees throughout the entire flowering time of the apple cultivars. Pollinizer cultivars should be planted between every sixth or seventh tree in the row, but not more than 50 feet apart. The pollinizer should be planted in every row because bees usually move only up and down in the tree row. Therefore, little pollination would occur if the pollinizers were in another row.

The pollinizer trees should be trained as poles, producing a single flowering branch that should grow higher than the trees on the main apple cultivar. It should not be forgotten that other factors are going to influence pollination in the orchard, such as temperature, sunlight, raind, wind, hail, tree nutrition, pests, and diseases of both the crabapple pollinizers and the main apple cultivar.

An average soil fertility level supporting the growth of fruiting trees is suitable for the flowering crabapple.

Cold weather just before the bloom period can injure the ovules and the pistils. The flowers open, but they won't set fruit. The pollen can be destroyed by cool temperatures. Frost injury can occur after the flowers are in bloom or after the petals shed. Prolonged cool, rainy, cloudy, or windy weather during the bloom period inhibits the activity of the bees that do not fly below 65 degrees F.

Research shows that the use of crabapples as pollinizers in apple orchards is more economical that using other commercial apple cultivars for pollination. More research is needed for the selection of an ideal crabapple pollinizer for use in apple orchards.

TABLE I. THE CHARACTERISTICS OF SELECTED CRABAPPLE CULTIVARS

Cultivar	Ploidy	Petal Color	Corolla Whorl	Bloom Time	Average # of Anthers Per Flower	Fruit Size (cm)
Chestnut	diploid	white	single	early, mid-season	20	1.5 - 3.0
Golden	diploid	white	single	mid-season	19	1.5 - 3.0
Manchurian	diploid	white	single	early, mid-season	20	1.5 - 3.0
Pearleaf		white w/pink	single	mid-season, late		
Pioneer Scarlet	diploid	light red	single	mid-season	20	1.5 - 3.0
Rosedale	diploid	light pink	single		19	1.5 - 3.0
Snowdrift	diploid	white	single	mid-season, late	20	< 1.5

TABLE II. THE CHARACTERISTICS OF SELECTED CRABAPPLE CULTIVARS

Cultivar	Relative amount of Pollen Shed	% Anthers open After Drying	Number Pollen Grains/Anther	% Pollen Germinated	% Collapsed Pollen
Chestnut	heavy	50	2,203	42.7	14.5
Golden	heavy	100	5,034	48.3	1.7
Manchurian	heavy	80	1,542	51.2	3.3
Pearleaf					
Pioneer Scarlet	heavy	100	6,177	43.8	20.0
Rosedale	heavy	100	3,226	66.5	17.7
Snowdrift	heavy	100	3,140	54.0	5.0

TABLE III. THE CHARACTERISTICS OF SELECTED CRABAPPLE CULTIVARS

Cultivar	% Fruit Set Delicious	McIntosh	Golden Delicious	Disease Resistance Scab	Fire Blight	Powdery Mildew
Chestnut	20	19.6	48	resistant		
Golden	10	17.1	35	slight, severe		
Manchurian	7.7	25	55.6	severe		moderate
Pearleaf				susceptible		
Pioneer Scarlet	10	2.4	32.3			
Rosedale	20	50	56.5			
Snowdrift	7.4	4.2	15.4	severe	severe	

MALUS 'ADIRONDACK'

Erik A. Neumann
Head, Education Unit
U.S. National Arboretum
Washington, D.C.

Because of the range of pests and diseases that affect crabapples, the National Arboretum has undertaken a breeding project to develop disease-resistant crabapple cultivars with superior landscape characteristics. One of the first of the disease-resistant cultivars to come out of this program was a seedling from a plant of *Malus halliana* in the National Arboretum crabapple collection that was observed to be consistently free of diseases. Five hundred seedlings raised from the open-pollinated seed of this species were inoculated artificially with fire blight bacterium under controlled conditions. Of this number, only 60 resistant seedlings were retained for field testing. Some of these fire blight-resistant seedlings also showed resistance to apple scab, cedar-apple rust, and powdery mildew during 11 years of field trials. 'Adirondack' was selected from these resistant seedlings.

Malus 'Adirondack' is a significant National Arboretum crabapple introduction with multiple disease-resistance and a narrow obovate (egg-shaped, with a broader tip), upright growth habit. There are few crabapples in the nursery trade with an upright growth habit, and these have variable resistance or tolerance to disease.

'Adirondack' is a small, tree that has a pronounced vertical branch structure. At the National Arboretum it has grown 12 feet high, with a spread of 6 feet in 13 years. The foliage of this cultivar is an attractive dark green in the summer. Its dark carmine buds mature to a lighter red over a period of weeks, before opening to wide-spreading waxy white blooms in mid-April. The pendulous orange-red fruit remains on the tree until December and, because of its small size, litter and maintenance problems are minimal. The colorful red buds, white flowers, and

orange-red fruits are all attractive when viewed close up and provide a showy mass display when viewed from a distance. Like other crabapples, 'Adirondack' is adaptable to a wide range of soil, moisture, and climatic conditions. It is hardy to USDA Zone 4, and thrives in a heavy, well drained, but moist loam with a pH of 5.0 to 6.5. For optimum flowering and fruit production, it should be grown in full sun. This crabapple cultivar requires little pruning because of its dense branching and compact, upright growth habit. 'Adirondack' provides a superb display of spring flowers and fall fruit for the home garden or shrub border, in parks or recreational areas, suitable as a screen plant or as a street tree where power lines impose height restrictions.

Malus 'Adirondack' is available in the nursery trade so you can grow and enjoy it in your garden.

I consider *Malus* 'Adirondack' to be one of the most promising crabapple for use on parkways where more wide-spreading cultivars are more difficult to use.

T. Green, Executive Director

COLLECTION OF WILD APPLE IN MIDDLE ASIA

E. E. Dickson
P. Forsline

The cultivated apple is believed to have originated from wild apple species (*Malus sieversii*, *M. kirghisorum*, *M. niedzwetzkyana*) that are native to the forests of Middle Asia. Growing in association with these apple species are other fruit crop relatives, perhaps those found in the original "Garden of Eden." As part of an overall program to preserve the genetic diversity of apple and other plants of horticultural importance, the USDA National Plant Germplasm System has sponsored several collecting expeditions to Middle Asia. This report is about our recent three-week expedition to the former Soviet republics of Kazakhstan and Kyrgyzstan, taken during September of 1993.

The purpose of the expedition was to collect genetically diverse seed from apples, as well as from other fruit crop relatives. Ultimately, we sought wild material with genes for disease and insect resistance, genes that are important for cultivar improvement. Assuming that genetic diversity can best be found among plants growing in varied ecological habitats, our goal was to collect apples from as many different habitats as possible. Seeds from these collections are currently being stored at the USDA-ARS Plant Genetic Resources Unit (PGRU) in Geneva, NY. These seeds will be made available to scientists for study and breeding purposes. Dried leaf specimens from trees from which we collected seed are being stored at both Cornell (BH) and the National Arboretum (NA) as vouchers.

The collecting team consisted for four members: Philip Forsline, Curator of Apple and Grape, USDA-ARS, Geneva, NY; Gaylord Mink, Plant Pathologist, Washington State University, Prosser WA; Elizabeth E. Dickson, Plant Taxonomist, Cornell University; and Dominique Noiton, Apple Breeder, Horticulture Research

Institute, Havelock North, New Zealand. This expedition is part of an exchange program coordinated between Phil Forsline and Calvin Sperling (USDA-ARS) and Prof. Aimak Djangeliev of the Kazakhstan Academy of Sciences. Our hosts included the Main Botanical Garden in Alma Ata, the Committee of Forestry for Kazakhstan, the Kazakh Research Institute of Fruit Growing and Viticulture, and the Institute of Forestry and Walnut Breeding, Bishkent, Kyrgyzstan. In exchange for hosting us, four representatives from the Kazakh institutions visited fruit breeding programs, germplasm units and other research programs in the western USA during October of 1993.

After we arrived in Moscow, we spent the first two days adjusting to the time change and sight seeing. On the third day, we flew Aeroflot to Alma Ata, the capital of Kazakhstan, our home base for the duration of the expedition. The following day, we took a two-hour helicopter flight over Kazakh mountains, grassland and desert to our first collection site in the Tian Shan mountains.

While in the field, we worked almost constantly, hiking mountains, collecting material, making notes, and extracting seeds at night. We were able to accomplish a great deal because of the support and assistance of our hosts. Besides the forestry officers and botanists who helped us in the field, several women stayed in camp to prepare our meals. In the morning we were greeted with a breakfast of bread, pastries, jams, honey, tea, and sometimes meat stew. Our lunches in the field could be simply leftover bread, tea, tomatoes, and canned fish, but more elaborate lunches were usually prepared at camp. Dinners, however, were always a big production, with traditional Kazakh dishes and plenty of vodka and cognac. Shish kebob, lamb stews, homemade noodles and dumplings, freshly caught fish, tomatoes, and pilaf would be piled in front of us to eat. We often had to plead with our hosts not to be overfed and not to overdrink. But sometimes there was no polite way to resist trying strange items such as very greasy broth, homemade vodka, or fermented mare's milk.

The accommodations were primitive; no hot water, usually no running water, and an outhouse with a hole in a wooden floor were the typical conditions in which we lived. We shared rooms in bunkhouses at forestry camps and slept on cots. Sometimes we

would eat or work inside a yurt, the traditional nomadic Kazakh felt-covered tent. The wood-heated hot sauna baths were a much appreciated treat in which we indulged every few days.

Our companions were amazingly generous, open, curious, and good humored. Most of the time we had an interpreter, a 23-year-old woman (Saule Dusembina), who attends Alma Ata University. We managed to communicate through gesture and with broken Russian and German when our interpreter was absent. We shared work, meals, and laughter, and became good friends.

Working with our hosts, we collected material from five main geographic sites: 1) near Topolevka, Kazakhstan in the Dzhungarsky Alatau; 2) near Lepsinsk, Kazakhstan, also in the Dzhungarsky Alatau; 3) in the foothills near Alma Ata, Kazakhstan; 4) by the Borolday River in the Karatau Alatau, Kazakhstan; and 5) near Koumhama, in the Ferganskiy Kherbet, Kyrgyzstan.

Near Topolevka and Lepsinsk were forests that were dominated by apple trees. Wild currant, blackberry, and hops were also growing in these regions along with poplar, spruce, and pine. There were obvious morphological variations in the leaf and habit of apple trees that made up these natural populations. Fruit varied in diameter from one to three inches; color from green, yellow, to red; in taste from bitter or astringent to pleasant, and from sour to sweet; and in texture from soft to crisp.

In a milder region near Alma Ata, we visited foothills that had apples on the northern slopes and native apricots on the warmer south-facing slopes. Although we collected apples, it was too late in the season for apricots. Apricot fruit had already fallen from the trees or had been picked. Because the city is nearby, the hillsides are being built with houses and dug for gravel. Pressures from human activities have decreased the number of wild trees in recent times, giving emphasis to the importance of preserving wild fruit habitats quickly.

The driest area that we visited was near the Boralday River. We collected from the few wild apple and pear trees that were found growing there in a scattered pattern. More frequently distributed

than the apples, were the hawthorn trees (*Crataegus pontica*) which had delicious yellow fruit with an almost citrus-like flavor. Pistachio and almond species were also collected from this canyon site. Exciting as it was to find these wild nut species, the most wonderful discovery was the sweet and juicy grapes (*Vitis vinifera*) growing along the river. We collected grape seed from red, white, and black color forms and tasted them all.

A second helicopter ride took us to the village, Koumhama, in Kyrgyzstan. From there we explored several sites as well as an Experimental Farm. The high mountains were rugged and steep, but we were able to obtain apples, pears, plums, and walnuts in the forests at lower elevations. The forests were dominated here by walnut.

It was a rare experience to visit a region of the world where many of our most valued cultivars may have originated. We were left with a sense of history, a history of humans selecting favored forms, and propagating and spreading fruit through the Middle East, China, Europe, and eventually to North America. I hope that our collections will enrich the genetic base of cultivated apples for the future. Because spring frost in the region was severe, fruiting in the wild populations was limited. Therefore, a future trip in 1995 or 1996 is planned to sample more of this diversity.

THE HOLDEN ARBORETUM PARTICIPATES IN SEED COLLECTING EXPEDITION

Peter W. Bristol, Horticulturist
Holden Arboretum
Mentor, Ohio

As part of a collecting team organized by the North American China Plant Exploration Consortium (NACPEC), I spent five weeks in northeast China working and studying plants with Chinese foresters. NACPEC is comprised of seven gardens: The Arnold Arboretum of Harvard University, The Holden Arboretum, Longwood Gardens, Morris Arboretum of the University of Pennsylvania, The Morton Arboretum, University of British Columbia Botanical Garden, and U. S. National Arboretum. All have a strong interest in exchanging seeds, scientific information, and personnel with Chinese institutions.

The area selected for this expedition was Heilongjiang Province which is located in Northeast China, primarily north of the 43°, north latitude. Since Cleveland is just south of north 42° latitude, this is an appropriate area in which to collect. The climate and cold, temperate, mesic, vegetation is quite similar.

Upon arriving in Harbin, the capital of Heilongjiang Province, Mr. Paul Meyer of the Morris Arboretum, Mr. Kris Bachtell of The Morton Arboretum, and I were warmly greeted by Professor Jin, Tie-shan, Vice Director of the Heilongjiang Academy of Forestry and our host. Our initial eagerness and enthusiasm was soon temporarily dampened with the ponderous red tape of the Chinese government. Earlier in August, seed collecting and herbarium specimen processing supplies and gifts were shipped to Harbin. Our goal was to retrieve these quickly and head for the wild habitats to study plants and collect seed. After two and a half days and numerous visits to five different offices, the thirty-five boxes of supplies were finally released.

In order for a plant exploration trip to be successful, a list of target species must be developed. Because of the background of the participants on this trip, emphasis for our search was placed on trees and shrubs. One interest was to seek plants that grow in bottomland or floodplain situations. These usually are tolerant of poor root-zone oxygen exchange comparable with conditions along urban and city streets. Other interests were toward plants that could complement breeding programs, such as *Viburnum*, *Ulmus*, *Acer*, and *Malus*, and reintroduction of plants with limited diversity of germplasm represented in cold temperate gardens. We used whatever texts were available and the advice of the Chinese to select the best areas in which to collect.

The first area we visited was a two-hour drive east of Harbin to a small mountain range in which the highest peak is called Pingshan. On the edges of the road to Pingshan, we noticed many plantings of healthy poplars as street trees. These were often planted 10 to 15 feet apart and two to three rows deep. After thirty years, trees are selectively removed for timber.

At the Heilongjiang Forest Academy, Pingshan Wild Animal Experimental Farm, we collected for two days in young second-growth forests. Only a few older trees had been preserved as seed trees and had a diameter at breast height (dbh) greater than 12". The diversity of plants was exciting - especially since we were seeing plants we were familiar with, such as *Quercus mongolica*, *Juglans mandshurica*, *Tilia amurensis*, and *Sorbus alnifolia*. Seeds collected from plants, that are of a value to The Holden Arboretum, include: *Tilia mandshurica*, *Crataegus pinnatifida* var. *psilosa*, *Corylus mandshurica*, *Betula platyphylla* and *Populus koreana*. These are all new as wild collected germplasm. *Malus baccata*, Siberian Crabapple, was found growing along an old field edge. The tree was 18 feet tall with lovely bright red glossy small fruits and had ascending branches. One observation of this area which had us and our guides baffled was the large quantity of insects: mosquitoes, stinging caterpillars, and seed-eating larvae. We were encouraged to see that the foliage of the crabapple was relatively clean of pests in this native site.

In the field we took enough specimens of leaves and fruits of the plants on our list so that all participating gardens could have a voucher for their herbarium, to aid in identification at a later date. Immediately upon returning from the field, we pressed and dried our specimens and began the seed-cleaning process. This work usually lasted late into the night.

During our last day in Pingshan, Professor Jin, Tie-shan received notification from authorities to whom he had earlier reported our visit. As of July 1992, there had been a change in the regulations for foreign seed collecting. Professor Jin, Tie-shan would have to apply for a special permit for us to leave China with any material: seeds or herbarium specimens. Since all of us thought that this had been adequately taken care of, we were confused and worried.

What was to be a short turnaround time in Harbin before heading back to new collecting sites, resulted in an extended stay of four days. We waited for authorities and our hosts to approve new cooperative agreements and to secure new permits for us to continue. Plans for an early termination of the trip were considered as well as other options that had all of us on a roller coaster of emotions.

In the meantime, we processed our seeds and herbarium specimens. We cleaned the fleshy fruits by removing the outer tissue, and we dried the capsules to extract the seeds. Cleaned seeds were packed for customs inspection. We changed the drying papers in the herbarium presses to keep our voucher specimens dry. *Malus baccata* and *Crataegus* are particularly difficult fruits to clean, especially when they are picked early in the season. The fleshy part has to be crushed and fermented for several days before it is soft enough to separate the seeds from it. The Chinese showed great interest as we stomped on and pounded the fruits.

Provincial approval was finally granted for limited collecting at Jiangshanjiao. We loaded the minibus and headed southeast to Jiangshanjiao. The first two hours of riding were exciting for us. Driving past farm country, we noted that the fields were large and similar to a size commonly seen in Ohio. In other parts of China, the farm fields are often small individual plots divided by

clay paths and ridges. The crops were corn, spring wheat, rice, and soybeans. The paved road soon deteriorated to a dusty dirt road, then to little more than two ruts which often had huge moguls that twisted and jarred the vehicle, causing its passengers and supplies to toss and bounce about inside. A new four-lane highway is being built from Harbin to the Russian border. When the existing road was used for construction of the new highway, vehicular access was forced onto temporary roads in fields and woods. After traveling for ten hours and only 275 miles, we arrived shaken and tired at the Jiangshanjiao Forestry Experiment Station of the Heilongjiang Academy of Forestry located at 44° north latitude.

Here the vegetation is very diverse. Within a few hundred feet of one another, there were five maples — all of which were on our target list: *Acer mono*, *A. mandshuricum*, *A. tegmentosum*, *A. triflorum*, and *A. ukurunduense*. The native forest was primarily a mixed needled-evergreen and deciduous flora. Ground covers of *Equisetum* and *Paris* carpeted low moist areas. We concentrated on native areas along roadsides, logging roads and edges of logged sites, where we found *Syringa reticulata* var. *mandshurica*, *Acer ginnala*, two *Acanthopanax species*, *Malus baccata*, *Viburnum sargentii*, *V. burejaeticum*, and *Euonymus pauciflorus*. Most logged sites had smaller trees remaining especially *Betula platyphylla*, which will be cut later for chopsticks. Sites were quickly replanted, often with larch and Korean pine. Our interest in firs and spruces which are found at slightly higher and drier elevations was increased when we found a log of *Abies holophylla* that was 35.5" in diameter.

We requested to see living trees of this species and we were treated the next day to an exploration of a mature forest with maples, *Quercus mongolica*, *Abies nephrolepis*, *Abies holophylla*, *Tilia mandshurica*, *Populus koreana*, *Juglans mandshurica*, and *Pinus koraiensis*. Fall was beginning to paint the leaves of *Acer mandshuricum* and *A. triflorum* fiery red; *Phellodendron amurense*, *Betula species*, and *A. tegmentosum* shades of primrose yellow, and *Viburnum sargentii* and *Ulmus* species Burgundy reds. Weaving in and out were the translucent pink leaves of a grape, *Vitis amurensis*, and butter yellow leaves of *Schisandra chinensis* with

its bright red fruit. Grapes, raspberries, *Rubus crataegifolius*, and hardy kiwis, *Actinidia arguta*, were favorite grazing foods for us.

Jiangshanjiao, meaning beautiful river and mountain, is located east of a large lake, Jing Po, formed by volcanic activity 8,000 years ago. On the eastern shore there is a drier more open habitat than the forest that we had been exploring to date. The site yielded different species of interest: *Juniperus rigida*, *Securinega suffruticosa*, *Rhododendron mucronulatum*, and *Maackia amurensis*. *Maackia* is a small tree that is generating interest among horticulturists because it grows in a wide diversity of habitats. It has the potential as a city street tree because of the vase-shaped habit and a height less than 40 feet. In China, the wood is often used for valuable veneer and for fences, since it is highly rot resistant.

Even after ten days in Jiangshanjiao, we were saddened to leave this beautiful site to return to Harbin. Our last night there coincided with Kris's birthday, which called for a banquet. During our discussions with the directors of the Academy, we came to an informal understanding to assist them in establishing a North American Botanic Garden at Jiangshanjiao. We would cooperate by sending seed and scientific literature to them. Upon returning to our rooms we turned on the lights. A few minutes later, loose papers in the herbarium drier caught fire from a short-circuited Chinese extension cord. Quick action saved our specimens - what a grand finale!

During our two days in Harbin, we packed up our collecting supplies and sent them to the Beijing Botanical Garden for next year's expedition and processed our seeds and herbarium voucher specimens. Our next trip was to take us to Yichun-Wuying and the Fenglin National Nature Preserve. This area is 80 miles south of the Russian border at the 48° latitude. Fenglin has a natural forest consisting of 75% Korean pine, *Pinus koraiensis*. We were most impressed by the mature stands of forest trees. Some of the size figures noted are: *Pinus koraiensis* - 32" dbh, *Tilia amurensis* - 21" dbh, *Betula costata* - 33" dbh. The *Betula costata* was most impressive with its peeling brassy gold bark - sometimes in sheets one foot square. We were also excited about an uncommon

variant of *Acer mono* which had brilliant red to purple-red fall foliage. More commonly it has yellow fall color.

We collected few seeds in this preserve honoring, the request by the Chinese authorities to limit collecting. However, during our hike through the Korean pines we came across some pine nut collectors who were pleased to sell us some freshly gathered seed. Pine nuts are delicious served with tea, stir-fried and eaten fresh.

The one day we visited Fenglin was a cool, beautifully clear, fall day. The next day, we woke up with our rooms at 45°F and an overcast rainy day. We left the Research Station at 6:00 a.m. for Harbin.

Our hosts were always generous with their time to discuss plants and culture of Chinese. Guides and interpreters were available to us. Mr. Gao, ShiXin worked at the Academy and learned English from the Voice of America. He wanted to practice speaking and has a goal to study at an American university. Mr. Liu, Jun was the Project Manager for the Academy and coordinated the activities for foreign dignitaries.

Our hosts provided unlimited amounts of delicious food with a wide diversity of choices. They preferred good restaurants to picnic lunches in the field. When we were traveling, we would occasionally stop by a roadside market to purchase the local commercial crabapples, which are quite delicious. These are between one to two inches in diameter; and some are quite sweet and others crisp and tangy. A sample serving for a supper began with tea and fresh fruit: grapes, bananas, apples, native kiwi, and native raspberries. The main course was fried chicken, cold beef, and pork slices. Fresh beef was grilled at our table and dipped into a salt and spice mix. The main spice was prickly ash seed. Then came a light chip made from rice and shrimp. There were two fried fishes in a brown sauce, then wild wood ear mushrooms in a garlic, ginger sauce, corn on the cob covered with sticky starch sauce, a rice doughnut filled with bean curd and rolled in sugar and soup with pork meat balls. Sorghum wine, beer, fruit drinks, and tea were available. The fruit tray was passed again for dessert.

We brought back eighty-two taxa, primarily as seed; among them sixty-two taxa collected as wild germplasm are new to The Holden Arboretum from China. Of those 62, fifteen woody and 11 herbaceous species are totally new to the Arboretum. In turn, seed has been collected in the U.S. to share with our Chinese peers. The cooperative effort between the gardens of NACPEC and our Chinese hosts at the Heilongjiang Academy of Forestry proved to be very successful. The experience was rewarding for the individuals on the expedition as well as rewarding for the sponsoring institutions which will have their collections diversified. With new germplasm, observations will be made for tolerance to climate conditions such as summer heat and winter cold; insect and disease resistance; and ornamental potential with better fruit, flower, bark, or habit. New plants will be potentially useful for breeding.

ARIE DEN BOER ARBORETUM

Mike Woods
Pat Howard
Des Moines Water Works

Introduction

The Arie den Boer Arboretum, developed by Arie den Boer, is located in the 1,200-acre Water Works Park in Des Moines, Iowa. Mr. den Boer started the arboretum with 50 crabapple varieties, which over the years has expanded to approximately 265 varieties and over 1,200 crabapple trees on 20 acres of land located near the downtown of Iowa's capital city. Den Boer's research and knowledge regarding crabapple trees are renowned, and have been used throughout the horticulture community. During the spring blossoming, the Arboretum is host to thousands of visitors who view the abundance of color and fragrances year after year.

A staff of three gardeners is responsible for the care and record keeping of the crabapple trees in the Arboretum. Maintenance activities include pruning all crabapple and ornamental trees, propagating crabapples for variety longevity, and seeding annual plantings. To protect the trees from disease and pest damage, licensed Water Works' employees apply pesticides when warranted. The selected pesticides are very mild in toxicity and allow for reentry when the pesticide has dried, thus making the park as safe as possible for patrons and employees. Signs are posted in the area to alert patrons of the pesticide application and the hazard of consuming any fruit.

Water Works' records of crabapples trees are contained in a series of notebooks that include a listing of existing trees, a detailed map showing tree locations, variety, and the identification number of each tree in the arboretum. If a tree dies or is replaced, that information is also recorded. Trees in the Arboretum are marked with a wooden tag and metal label containing the name, origin, date planted, and tree identification number. A permanent record is housed at the security guard station so that visitors can easily locate specific trees whenever the park is open.

Because some crabapple varieties are no longer available through nurseries, and are considered rare, the gardeners graft the trees to produce offspring. Once mature, these specimens are planted in the Arboretum to continue the life of a variety. Each year, staff members graft several hundred specimens for future plantings; they have a 90% success rate.

Because of the park's central location in the city, Water Works Park is a popular area for biking, walking, jogging, bird watching, weddings, photography, and horticultural activities. An area of the park is available for overnight camping for organized groups, and an extensively planted fountain area is especially popular for weddings and other special events. The park is free and open to the public every day of the year, except for New Year's Day, Thanksgiving, and Christmas Day.

Flood of 1993

The Des Moines Water Works and the Arie den Boer Arboretum are located along the Raccoon River, which has a history of its damaging floods. Historical documents show major flooding in 1947, 1986, and 1990. The flooding experienced in 1993 was extreme and caused extensive damage to the Arboretum and crabapple trees. In July 1993, all nursery stock in the Water Works Park was destroyed by the ravaging flood water nearly 10 feet deep. This loss included 250 crabapple trees of 1" caliper or larger, 300 newly grafted crabs, and over 500 evergreens and deciduous seedlings. In addition, annual plantings and many sodded areas were destroyed.

After the flood, a massive cleanup effort was undertaken in the park and Arboretum areas. Approximately 100 crabapple trees were removed, uprooted by the flood waters. Older trees with weakened trunks were knocked over by the river's current, while others suffocated due to the length of time the water remained in the arboretum. Although there was a significant loss, the majority of the trees showed their tolerance to excessive moisture, and displayed new growth promptly after the water had receded.

To replace the varieties lost in the flood and to establish the Arboretum again, the Water Works intends to acquire scion

material from outside sources. The staff is also planning to introduce new, disease-resistant varieties in the arboretum. Just before the flooding, many newer varieties were purchased as whips and temporarily located in the nursery. Because of their immaturity, they were also lost in the flood.

Gateway to the City

In the spring of 1990, a project was initiated to beautify Fleur Drive, a heavily traveled street between the Des Moines International Airport and downtown Des Moines, acting as a gateway to the city. This was a joint effort between the City of Des Moines Parks & Recreation Department and the Des Moines Water Works. Initially, 81 crabapple trees were planted in a mile-long stretch of medians along Fleur Drive. Upon completion of the project, 159 trees have been planted in 3.5 miles of medians. Additional trees are added as funds allow. Basing the selection of trees upon their disease resistance, bloom color, and spread, the trees planted were 1 to 2" balled and burlapped. The cultivars included 'Indian Summer', 'Redbud', 'Selkirk', 'Mary Potter', and 'White Angel'. The performance of the trees hasn't met with expectations. A pattern of significant dieback of the previous year's growth each spring has been established. In addition, they are late in setting foliage, and bloom has been very light.

Several nurserymen have analyzed the problems encountered with the trees in the medians. Their opinion is that the high concentration of salt left on the medians from winter road maintenance may be burning the tree's roots. In an attempt to remedy this problem, Water Works' employees make sure at least 4-6" of mulch is around each tree before winter. It's hopeful the concentration of salt will weaken before it leaches down to the roots and burns them when growth starts in the spring.

Donor Tree Program

Four years ago the Water Works implemented a donor tree program to add new trees to the Arboretum. For a minimum donation of $100, Des Moines Water Works will select and plant a crabapple tree in the arboretum in honor or memory of an individual, or group of individuals. The donated trees provide

beautiful living memorials to be visited each spring while blooming. The permanent tag on each donor tree displays to whom the tree was dedicated, the name of the donor(s), and the variety of the tree. A short planting ceremony is held, and the donor and guests may participate with music, poetry, or other remembrances. The monetary donations are used to provide nursery stock to replace trees in the Arboretum as necessary.

Water Works' staff will continue to restore the Arboretum and the grounds to its pre-flood condition. They will also introduce new, hardier varieties to the arboretum and keep the original works of Arie den Boer growing in their collection.

RECOMMENDED DISEASE-RESISTANT CRABAPPLE TREES

Name	Height	Spread	Structure	Flowers	Fruit
Adams	20'	20'	round	deep pink buds open to clear red	red, 3/8"
Centurion	20'	15'	narrow, upright	rose-red, single	bright red 5/8"
David	12'	12'	compact, rounded	light pink buds open to white	bright red 3/8" to 1/2"
Henry Kohankie	20'	20'	rounded	pink buds open to white flowers, single	red, 1¼"
Indian Summer	18'	20'	rounded	rose-red	bright red, 1/2" or less
Jewelberry	8'	12'	dwarf,round dense	white with pink edge	bright red, 1/2"
Ormiston Roy	20'	25'	upright when young, broaden with age	pink buds open white	yellow with orange blush 3/8"
Pink Princess	8'	12'	low spreading	rose-pink	deep red, 1/4"
Prairifire	20'	20'	upright, spreading becoming rounded	crimson buds open to bright pinkish-red	dark red, 1/4"
Professor Sprenger	20'	20'	upright, spreading	pink buds open to white	orange-red, 1/2"
Robinson	25'	25'	upright, spreading with age	crimson buds turn to deep pink	dark glossy red, 3/8"
White Cascade	15'	15'	weeping	pink buds open white	yellow, 1/2" or more

DES MOINES WATER WORKS' CRABAPPLE COLLECTION

Botanical Name	Trade Name
M. 'Abundant'	Abundant
M. 'Adam'	Adam
M. x adstringens 'Brier'	Brier
M. x adstringens 'Columbia'	Columbia
M. x adstringens 'Hopa'	Hopa
M. x adstringens 'Jewell'	Jewell
M. x adstringens 'Nipissing'	Nipissing
M. x adstringens 'Olga'	Olga
M. x adstringens 'Queen Choice'	Queen Choice
M. x adstringens 'Radiant'	Radiant
M. x adstringens 'Red Silver'	Red Silver
M. x adstringens 'Selkirk'	Selkirk
M. x adstringens 'Royalty'	Royalty
M. x adstringens 'Simcoe'	Simcoe
M. x adstringens 'Sissipuk'	Sissipuk
M. x adstringens 'Timiskaming'	Timiskaming
M. x adstringens 'Transcendent'	Transcendent
M. x adstringens 'Vanguard'	Vanguard
M. 'Alexis'	Alexis
M. angustifolia 'Plena'	Prince Georges
M. x arnoldiana	Arnold
M. x astracanica	Astracan
M. x astrosanguinea	Carmine
M. asiatica	Chinese Pearleaf
M. 'Athabasca'	Athabasca
M. baccata 'Columnaris'	Column Siberian
M. baccata 'Fairy'	Fairy
M. baccata 'Gracilis'	Gracilis
M. baccata himalaica	Himalayan
M. baccata mandshurica	Manchurian
M. baccata 'Nertchinsk'	Nertchinsk
M. baccata 'Oblonga'	Oblonga
M. baccata 'Praecox'	Praecox
M. baccata 'Spring Snow'	Spring Snow
M. 'Barbara Ann'	Barbara Ann
M. 'Bechtel Cutleaf'	Bechtel Cutleaf
M. 'Bedford'	Bedford
M. 'Beverly'	Beverly
M. 'Branzam'	Brandywine
M. 'Burgandy'	Burgandy
M. 'Cathay'	Cathay
M. 'Centurion'	Centurion
M. 'Chrishozam'	Christmas Holly™
M. 'Coralburst'	Coralburst
M. coronaria angustifolia	Southern
M. coronaria bracteata	Buncomb
M. coronaria dasycalyx	Great Lakes

Botanical Name	Trade Name
M. coronaria dasycalyx 'Charlottae'	Charlotte
M. coronaria dasycalyx 'Elk River'	Elk River
M. coronaria elongata	Rehder Sweet
M. coronaria glabrata	Biltmore
M. coronaria lancifolia	Allegheny
M. 'Dauphin'	Dauphin
M. 'David'	David
M. 'Delite'	Delite
M. 'Donald Wyman'	Donald Wyman
M. 'Dorothea'	Dorothea
M. 'E. H. Wilson'	E. H. Wilson
M. 'Ellen Gerhart'	Ellen Gerhart
M. 'Ellwangeriana'	Ellwanger
M. 'Evelyn'	Evelyn
M. 'Exzellenz Thiel'	Exzellenz Thiel
M. 'Flame'	Flame
M. flexilis	Flexilis
M. 'Florence'	Florence
M. floribunda	Floribunda
M. floribunda 'Bob White'	Bob White
M. floribunda 'Kelsey'	Kelsey
M. 'Geneva'	Geneva
M. 'Giant Wild Crab'	Giant Wild
M. 'Gibbs' Golden Gage'	Gibbs' Golden Gage
M. x gloriosa	Gloriosa
M. 'Gold'	Gold
M. 'Goldfinch'	Goldfinch
M. 'Golden Anniversary'	* Golden Anniversary
M. 'Golden Hornet'	Golden Hornet
M. 'Guiding Star'	Guiding Star
M. 'Gurney Sweet'	Gurney Sweet
M. halliana	Halls
M. 'Hargozam'	Harvest Gold™
M. x hartwigii	Hartwig
M. 'Helen'	Helen
M. 'Henrietta Crosby'	Henrietta Crosby
M. 'Henry F. DuPont'	Henry F. DuPont
M. 'Henry Kohankie'	Henry Kohankie
M. 'Heterophylla'	* Heterophylla
M. 'Hilborn Pyramidal'	Hilborn Pyramidal
M. honanensis	Honan
M. hupehensis	Tea
M. hupehensis 'Cornell'	Cornell
M. 'Indian Magic'	Indian Magic
M. 'Indian Summer'	Indian Summer
M. ioensis	Prairie
M. ioensis 'Klehm's Improved Bechtel'	Klehm's Improved Bechtel

Botanical Name		Trade Name
M. ioensis 'Nova'		Nova
M. ioensis palmeri		Palmer
M. 'Irene'		Irene
M. 'Ivan'		Ivan
M. 'John Downie'		John Downie
M. 'John's'		John's
M. 'Keo'		Keo
M. 'Kibele'		Kibele
M. 'King's'		King's
M. 'Kit Trio'		Kit Trio
M. 'Kola'		Kola
M. 'Late Hyslop'		Late Hyslop
M. 'Linda'		Linda
M. x magdeburgensis		Magdeburg
M. 'Manbeck Weeper'		Anne E
M. 'Manito'	*	Manito
M. 'Martha'		Martha
M. 'Mary Potter'		Mary Potter
M. 'Masek'		Masek
M. 'Mathew'		Mathew
M. 'Mercer'	*	Mercer
M. x micromalus		Midget
M. 'Minnesota'	*	Minnesota
M. x moerlandsii 'Liset'		Liset
M. 'Molazam'		Molten Lava®
M. 'Mrs. Bayard Thayer'		Mrs. Bayard Thayer
M. 'Nancy Townsend'		Nancy Townsend
M. 'Nebo'	*	Nebo
M. 'Neville Copeman'		Neville Copeman
M. 'Oekonomierat Echtermeyer'		Echtermeyer
M. 'Oporto'		Oporto
M. 'Orchid'		Orchid
M. 'Ormiston Roy'		Ormiston Roy
M. 'Osman'		Osman
M. 'Patricia'		Patricia
M. 'Pattie'	*	Pattie
M. 'Pink Cascade'		Pink Cascade
M. 'Pink Spires'		Pink Spires
M. 'Pixie'		Pixie
M. x platycarpa 'Arlington'		Arlington
M. x platycarpa 'Rosedale'		Rosedale
M. 'Ponass'	*	Ponass
M. 'Prairifire'		Prairifire
M. 'Printosh'		Printosh
M. prunifolia 'Fastigiata'		Column Pearleaf
M. prunifolia fructu coccinea		Cheal's Crimson
M. prunifolia lutea		Prunifolia Lutea

Botanical Name		Trade Name
M. prunifolia 'Maliformis'		Prunifolia Maliformis
M. prunifolia microcarpa		Prunifolia Microcarpa
M. prunifolia microcarpa lutea		Prunifolia Microcarpa Lutea
M. prunifolia 'Pendula'		Weeping Pearleaf
M. prunifolia rinkii		Chinese Pearleaf
M. pumila 'Apetala'		Bloomless
M. pumila paradisiaca		Paradisiaca
M. pumila paradisiaca foleus aureus		Paradisiaca Foleus Aureus
M. x purpurea		Purple
M. x purpurea 'Aldenhamensis'		Aldenham
M. x purpurea 'Eleyi'		Eleyi
M. x purpurea 'Lemoinei'		Lemoine
M. 'Quaker Beauty'		Quaker Beauty
M. 'Ralph Shay'		Ralph Shay
M. 'Redford	*	Redford
M. 'Red Barron'		Red Barron
M. 'Redfield'		Redfield
M. 'Redflesh'		Redflesh
M. 'Red Heart'		Red Heart
M. 'Red Jade'		Red Jade
M. 'Redman'	*	Redman
M. 'Red Mercer'		Red Mercer
M. 'Red River'		Red River
M. 'Red Tip'		Red Tip
M. x robusta		Cherry
M. x robusta 'Beauty'		Beauty
M. x robusta 'Dolgo'		Dolgo
M. x robusta 'Erecta'		Column Cherry
M. x robusta 'Persicifolia'		Peachleaf Cherry
M. rockii		Rock
M. 'Rondo'	*	Rondo
M. 'Ruth Ann'		Ruth Ann
M. sargentii		Sargent
M. x scheideckeri		Scheidecker
M. x scheideckeri 'Hillier'		Hellier
M. 'Seafoam'		Seafoam
M. 'Sentinel'		Sentinel
M. 'Severn'		Severn
M. 'Shield'		Shield
M. sieboldii		Toringo
M. sieboldii arborescens		Tree Toringo
M. sieversii		Niedzwetzkyana
M. sieversii 'Chilko'		Chilko
M. sieversii niedzwetzkyana 'Cowichan'		Cowichan
M. sieversii niedzwetzkyana 'Erie'		Erie
M. sieversii niedzwetzkyana 'Makamik'		Makamik
M. sieversii niedzwetzkyana 'Scugog'		Scugog

DES MOINES WATER WORKS' CRABAPPLE COLLECTION Cont.

Botanical Name	Trade Name
M. sikkimensis	Sikkim
M. 'Slocan'	* Slocan
M. 'Snowdrift'	Snowdrift
M. x soulardii	Soulard
M. x soulardii 'George Eden'	George Eden
M. x soulardii 'Wild Red'	Wild Red
M. 'South Dakota Ben'	South Dakota Ben
M. 'South Dakota Bison'	South Dakota Bison
M. 'Sparkler'	Sparkler
M. spectabilis 'Plena'	Chinese Double Flowering
M. spectabilis 'Riversii'	Rivers Chinese
M. spectabilis 'Van Eseltine'	Van Eseltine
M. 'Strawberry'	Strawberry
M. 'Sugar'	Sugar
M. 'Sutyzam'	Sugar Tyme®
M. sylvestris	European Wild
M. sylvestris 'Plena'	Double Flowering
M. 'Thomas Roland'	Thomas Roland
M. 'Tolsteme'	Tolsteme
M. toringoides 'Macrocarpa'	Macrocarpa
M. 'Toshprince'	Toshprince
M. 'Trail'	Trail
M. tschonoskii	Tschonoskii
M. 'Turesii'	Turesii
M. 'University'	University
M. upsaliensis	Upsaliensis
M. 'Velvetcole'	Velvet Pillar
M. 'Virginia'	Virginia
M. 'Wabiskaw'	Wabiskaw
M. 'Weepcanzam'	Weeping Candied Apple™
M. 'White Angel'	White Angel
M. 'White Candle'	White Candle
M. 'Wickson'	Wickson
M. 'William Sim'	William Sim
M. 'Yaeger Sweet'	* Yaeger Sweet
M. 'Yellow Siberian'	Yellow Siberian
M. 'Young America'	Young America
M. yunnanensis 'Veitch's Scarlet'	Veitch's Scarlet
M. x zumi	Zumi
M. x zumi calocarpa	Redbud
M. 'Zita'	Zita

* These are probably apples rather than crabapples. Ed.

RECORD KEEPING AT DAWES ARBORETUM

Tamara A. Trites, Plant Records Specialist
The Dawes Arboretum
Newark, Ohio

Maintaining records on plants in any collection is challenging. Whether the collection is a nursery, small garden, or several hundred acres, records are a vital link between people and plants.

To maintain computerized plant records The Dawes Arboretum employs a database program called "FoxPro®." This program is used to generate a card file, plant lists for maps of collection areas, and adapts to our plant labeling system.

The Database:
FoxPro® is a fast, powerful, flexible database that allows information to be stored, manipulated, and retrieved in a myriad of ways. A special field type called "memo" is used to document larger pieces of data on individual plants. Separate files are kept for living and dead plants. When a plant has been removed, the record is sent to a dead records file. This allows documentation of plant type occurrences (dead or living), reasons for removal, etc. Each plant has a separate record.

Card File:
A customized report was designed to print all file data on a 5" by 8" index card for each plant in the collection. The card file is a hard copy of the computer file, providing noncomputerized access to all plant records. These cards are used by staff and volunteers. As plants are added/removed, corresponding cards are added/removed.

The Maps:
Early in The Dawes Arboretum's history, the grounds were surveyed into 100' by 100' quadrants. A survey marker exists at each quadrant intersection. Each quadrant is represented by a separate section map.

Each plant within a section is given a plant number. The combination of this plant number and section map number make up

a plant's "location #." No two plants have the same location number. (If a plant is removed, the number is retired.)

To map a plant, coordinates are determined from the survey markers, and the plant is assigned a location number. Once plant data have been entered into the database, a report is generated to list all the plants in a section. As plants are added/removed from the collection, maps and plant reports are updated.

The maps provide a definitive record of a plant's location. If a plant label is lost, plant coordinates and computer records provide all the information that is necessary for identification.

Plant Labels:
Plant labels provide information for both the public and staff.

Selected data is displayed on the labels. This data is sent from the computer records in FoxPro® to WordPerfect®. WordPerfect® is used to generate acetates that are negatives for Metalphoto® plant labels made in-house. The plant location number is displayed on each label. This location number is the key to all other records on the plant.

Summary:
The computer records provide an efficient, accurate way to document collections. The cards provide noncomputerized access to the same data. The maps provide accurate locations of plants, and labels provide a brief summary about each plant.

This method of record keeping has worked well for The Dawes Arboretum. Variations on this theme are used by many other organizations.

We welcome any questions regarding our records system. Please contact:

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