THE PINCUSHION CACTI -THE GENUS MAMMILLARIA

With over 175 species, Mammillaria is the largest genus of globular cacti. Collectors have long admired their diversity, diminutive size, floral display and ease of cultivation. Centered in Mexico, their range extends north into the U.S., east to the West Indies, and down through Central America into South America as far south as Peru. The garden’s collection of Mammillaria contains a good cross-section of the genus, and the plants in the Desert House display area give the visitor an idea of the incredible diversity within the genus.

The name Mammillaria is derived from the Latin mammilla, which means “nipple.” Unlike other cacti, the tubercles of pincushion cacti have not coalesced into ribs and remain separate. These tubercles are arranged in precise, mathematical, spiralling rows which cross over each other. Early cactus taxonomists separated different species by counting these criss-crossing rows, which usually number 5 and 8, 8 and 13, or 13 and 21.

The main diagnostic feature that sets Mammillaria apart is the position of the flowers. Unlike most other cacti, Mammillaria flowers do not originate from the spine clusters (called areoles), but instead emerge at the base of the tubercles, in the axils. Though generally small, the flowers are borne profusely in rings like a garland around the top of the plant. In many cases the flowers are followed by a ring of smooth, elongated, fleshy, bright red berries. The fruits are edible and are called “chilitos” in Mexico and Central America.

There is almost no limit to the variation of spines in Mammillaria. The typical stiff, bristly spination can vary in color from bright white through red and yellow to dark brown. In addition, the atypical Mammillaria plumosa has soft, feathery, white spines which cover the plant body. Many species, called “fishhook cacti,” have central spines with small hooks on the end that do not let go once they get hold of you. Mammillaria bocasana, the powder-puff cactus, combines the two. Superficially it looks very fluffy, but underneath the soft cottony spines lie short, brown, hooked spines that grab. Even stranger, Mammillaria pectinata is covered with comb-like spines that look like giant mealy bugs!

The flowers of Mammillaria are nearly as diverse as the spination. Although most have small white or pink flowers, Mammillaria senilis has large, scarlet-red hummingbird-pollinated flowers. The flowers of Mammillaria guelzowiana are over 2” in diameter and bright cerise-pink. (Any plant with the word “zowie” in it has to be good!) Some of the smallest Mammillaria species have the largest flowers; Mammillaria nossfeldiana only reaches 1”-1 1/2” in diameter, but consistently sports rings of 1” pink, candy-striped flowers around the top of the plant. The flowers of the hooked-spined Mammillaria beneckei are apricot orange and sweet-smelling. Probably the cutest, in my opinion, is Mammillaria theresae, a di-

Mammillaria nana
Mammillarias may be solitary or clustering in habit. A few solitary species can become small barrels over a foot high and wide. Most common, however, is a clustering habit with many small to medium-sized heads. Especially interesting are the dichotomous species, where the apex of the plant branches by splitting into two forks. These plants, such as *Mammillaria microthele*, are called “owl’s eyes” because of the unique pattern produced by this type of branching.

Cultivation of most mammillarias is easy and relatively straightforward. Heavily spined plants generally require high light and high heat. More openly spined species need partial shade and somewhat cooler temperatures. They require a well-drained, somewhat mineral, but nutritious soil mix. At the garden we use a formula of 50% red lava, 40% expanded shale and 10% sandy loam, and add a small amount of a low-nitrogen, time-released fertilizer. During the growing season (spring & summer), watering is done on a regular basis, whenever the plants completely dry out. A light, low-nitrogen fertilizer (25% strength) can be given monthly. For the plants to grow normally and flower the next season, a dormancy period is required. As winter approaches, water and fertilizer should be gradually withheld and the temperatures dropped in order to facilitate dormancy. Over-wintering temperatures should be held around 45-50°F and not allowed to go below 40°F. Exceptions to the rule are the Central American, Caribbean and Baja California species which require warmer, slightly moist winters.

If you are considering growing cacti for the first time, or if you’re an old hand at cactus cultivation, there are any number of *Mammillaria* out there for you. Take a few minutes the next time you’re visiting the garden and take a look at the Desert House display plants. I think you’ll understand the allure of this diverse and fascinating genus of cacti.

----Kurt Zadnik, Horticultural Staff

**GUNNERA CHILENSIS**

This *Gunnera chilensis* is only two years old and dominates the entrance to the South American Area. Native to Chile, it loves water, marshy soil and humid shade. *Gunnera chilensis* is also found in the Andean regions of Argentina, Peru, Ecuador and on to Colombia and Venezuela.

The gigantic leaf and leaf stalk, up to six feet tall, arise from a rhizome, a short fleshy stem that grows along the ground. Stems are covered with branched fleshy hairs that weave a coat over the base of the leaf buds.

Leaf stalks called “nalcas” in Chile are eaten peeled like rhubarb. When harvested at the right time they can be agreeably acid flavored. They also are used to make a kind of marmalade.

Areas on *Gunnera* stems may harbor colonies of *Nostoc* blue-green algae which initiate a symbiotic relationship with the host plant. The blue-green alga assimilates nitrogen from the air and transforms it into a form useful by the host plant. This nourishes the *Gunnera* and allows it to establish itself quickly in disturbed areas.

There are about 40 species of gunneras all native to the southern hemisphere. They range from South Africa, Java, Australia, Tasmania, New Zealand, Hawaii, through South America.

The reddish green flowers are formed on short stout stalks densely packed with flowers. Male flowers tend to be at the tops of the stalks, hermaphrodites and female flowers toward the base. The reddish yellow fruits contain one seed.

Plants can be propagated from fresh seed or by division of the rhizome.

----Peter Klement, Horticultural Staff
ETHNOBOTANY: PLANTS IN HUMAN AFFAIRS

As children, we waged daily wars against the brussel sprouts and turnips that appeared on our dinner plates, but the time has come to appreciate these vitamin-rich foods and their fellow vegetables as potential life support systems. Vegetables are important to keep us healthy. Vegetables contain several of the vitamins and amino acids vital to our existence, yet they comprise only one tiny group of plants that contribute to our well-being as humans. Thousands more plants have unrealized potential as life-sustaining resources.

Whether in the form of a cup of coffee to get one moving in the morning or medicine to keep a heart beating, plant products contribute to our daily welfare. Every person in the world depends on plants for food, drugs and other industrial products. We have available to us over 250,000 known species of flowering plants from which to draw our resources. Some of these plants can grow in extreme environments, implying that people living on arid land or other inhospitable realms don’t need to suffer from hunger. Thousands of plants remain undiscovered. Who knows what beneficial properties lie within their cell walls?

Approximately one out of every three plants is edible, which gives us an enormous array of future options (over 80,000) when deciding what crops to plant in a particular place. This might lead one to believe that a vast variety of food plants are grown throughout the world. However, only 150 plants are cultivated on a large scale, and fewer than 20 species produce 90 percent of the food we eat. Interestingly, 10,000 years ago our ancestors raised the same 20 crops, including corn, wheat, rice, barley, potato, tomato, and coffee. With all this plant diversity available to us, one might wonder why starvation exists. The problem lies in the meager quantity of food we currently produce. In order to meet every individual’s nutritional needs in the world within the next three decades, we have to increase our production of food by as much as three times. To meet this lofty goal, we must exploit genetically altered staple foods and plants that naturally grow in extreme conditions. Finding the foods to grow in areas populated by hungry people is a relatively easy task to conquer – getting them planted and distributed poses a far greater problem.

All these numbers might be giving you a headache. So as you drive to the pharmacy to buy medication, you might consider the contribution plants have made to medical discoveries. Over one half of our medicine originates from wild organisms, including the aspirin for that headache. Though it is a staggering figure, it comes as no surprise to those familiar with folk medicine: natives of each continent used plants for treatment of nearly every condition that ails us. In fact, several medications are commercially available today because of studies done on old folk remedies.

Plants also provide an alternative fuel source. A few species of plants are rich in hydrocarbons yet free of sulfur. They provide a cleaner version of petroleum than the petroleum isolated from sulfur-rich fossils. Even more amazing is the ability of these “clean plants” to grow in soil rendered useless by activities such as strip-mining. Not only do hydrocarbon-rich plants provide a renewable source of petroleum, they rehabilitate stripped land. Hence, we can have our petroleum cake and eat it too!

This is only a sampling of what the plant world has to offer us. Perhaps the 21st Century will become the golden age of botany with advances in genetics, chemistry, and communication paving the way to the kingdom of botanical treasures. The plants outlined under the following categories of food, drugs and industrial products are examples of plants that have provided a stepping stone to an expanding study of plant uses and are themselves amazing discoveries.

FOOD

Buffalo Gourd

(Cucurbita foetidissima)

Until recently, agriculturists overlooked gourds, members of the squash family, as a serious source of protein and edible oil. The buffalo gourd is among those squashes tolerant to extreme dryness, and offers both seeds and roots as food for people and livestock. The seed contains about 35% protein and 34% oil, matching the output of peanuts and sunflowers, but requiring much less water.

The entire buffalo gourd has potential for both food and industry. The fruit contains the seeds and a fleshy pulp. Crushed, the seeds produce oil for food and industrial use. The remaining pulp provides cattle feed. Underground, an immense, starchy root grows, reaching up to 30 kilograms after only two growing seasons. One root from a buffalo gourd grown in arid conditions after two growing seasons produces the same amount of starch as four or five potatoes grown under ideal conditions. A single plant can produce scores of fruits. The buffalo gourd is thus a valuable crop for otherwise barren places, yet it is entirely unexploited: it is not grown commercially anywhere.
Canna

The bright, fragrant flowers of canna s provide interesting ornamentals, yet the commercially useful part of the plant lies underground. The starchy root-like structures offer food for humans and for livestock. Australia cultivates Canna on a commercial scale, offering it in markets as “Queensland arrowroot.” However, those in the West Indies consume the most canna.

Among the more historically interesting parts of the plant are the dark, spherical seeds encased in a hard pod. The size and strength of the marble-like seeds assured them employment in useful ways ranging from substitute musket balls to beads on a rosary. The durability of the seeds is a curious phenomenon in itself: seeds from a rattle estimated to be 600 years old were recovered from an Argentinian tomb and grew into a fully functional flowering Canna compacta!

Lambsquarters
(Chenopodium)

In 5000 B.C., Native Americans cultivated Chenopodium for its fruits. Today, experimental gourmet chefs sautee its leaves with butter, salt, and pepper, and serve it alongside fillets of salmon. Though the history of Chenopodium as a cultivated grain extends into prehistoric times. It has long been prominent as a staple known as quinoa in the Andes. North American indigenous people developed cultivated strains with thin fruit walls, until corn and beans took over. This happened some 1000 years ago in the Midwest. Only recently has it become a popular candidate for cash-crop cultivation in otherwise infertile areas.

Both the seeds and the leaves possess high nutritional value and produce large harvests. The seeds contain 15% protein and 58% starch and could provide a nutritional boost to otherwise inadequate diets by being ground into flour for breads and cakes or used whole in soups. The leaves, equally nutritious, resemble the leaves of spinach in appearance and taste when prepared as one would prepare spinach. The farmers of the Andes would benefit the most by cultivating Chenopodium, as the plants can grow in altitudes of up to 13,000 feet and require little water. Raising the crops and using the products in their own diets would not only improve the farmers’ nutrition, but could improve the quality of their cattle as well: the by-products of the harvests make excellent fodder for cattle. The idea of raising Chenopodium as a cash crop met opposition from the farmers of the Andes, as they looked down upon the plant as an uncivilized crop. However, the number of Andean farmers opting to grow Chenopodium has risen considerably and its success has inspired scientists to create drought-resistant and other altitude-resistant strains. Hence, a plant that once sustained ancient Incas may provide us with a key to sustaining our own expansive population.

DRUGS

Wormwood
(Artemisia)

In the 19th and early 20th centuries Artemisia maintained two spots in every American household: one in the medicine cabinet, and the other in the liquor cabinet. Grandparents or great grandparents might remember the potent liqueur absinthe popularized by brewers in the early 1900s. Not only was absinthe over 70% alcohol, it contained a derivative of Artemisia, an extremely toxic plant which deadens the senses when eaten. The euphoric stupor that followed from drinking absinthe undoubtedly rocketed the beverage into popularity. However, this powerful drug had a few major side-effects, one of them being death. The U.S. government eventually banned the production of absinthe, thereby saving lives, but making few friends.

Artemisia served a more useful (and healthy) purpose in the medicine cabinet. In fact, Artemisia was on the scene as a pain-killer before anyone had heard of medicine cabinets: the Native Americans knew of its abilities to soothe wounds and probably passed it on to the early European settlers. Americans eventually began using it to cure every painful ailment from headaches to fevers to heart palpitations. More obscure uses of the poisonous plant included burning the leaves to chase the mosquitoes away.

As scientists learned years ago, mosquitoes spread malaria to humans. Ironically, the same plant whose burning leaves offered farmers relief from the irritating pests also supplies us with one of the most effective cures for malaria. Scientists in China recently discovered that Artemisia destroys the malaria parasite and is less toxic than other anti-malarial drugs. However, Artemisia does not appear to flourish in the tropics, where malaria thrives. Until scientists perfect the drug, smudge pots and fly-swatters will have to suffice.

Devil’s Apples
(Datura stramonium)

The fruit may look tempting to some, but Datura stramonium unleashes its vice onto anyone who eats its prickly protuberances. Insanity and even death follow from ingesting any part of the plant. Perhaps that is why it is commonly known as Devil’s Apple.

Datura stramonium grows as a native plant in warmer places of eastern and western hemispheres.
and its uses in human affairs date back to pre-historic times. The hallucinogenic and intoxicating effects of *Datura* fascinated Native Americans, who used the seeds in ceremonies such as male initiation rites. Ancient Peruvians also found the stupor-inducing plant useful, administering it to patients in primitive operations. In earlier centuries, druggists sold the seeds as medication to anyone who would buy it. Not surprisingly, people began abusing the intoxicating effects of *Datura* in both India and the Americas by adding the seeds to alcoholic drinks to heighten the inebriating experience. However, *Datura* is extremely poisonous and causes death when eaten in even small amounts.

The witches of the Middle Ages owe their magical flights to meet the devil to the hallucinogenic properties of *Datura* and its close relatives. *Datura* contains some compounds that cause hallucinations. The hallucinations caused by the alkaloid scopolamine resemble flights through a nighttime sky. Hence, the obscure ingredients for a witch’s brew such as wing-of-bat or eye-of-newt may vary from cauldron to cauldron, but *Datura* or a close relative appears in every witch’s recipe.

*Datura* is not entirely evil, however. As with other toxic plants, *Datura* provides us with a useful medicinal tool. The same alkaloids that mentally levitated witches play integral roles in modern medicine. Asthma patients use *Datura* alkaloids to relieve bronchial spasms, and eye doctors use scopolamine to dilate their patients’ pupils. Although *Datura* stramonium may seem a malicious plant when abused, it is actually beneficial when broken down into its chemical components.

Madagascar Periwinkle
(*Catharanthus roseus*)

In North America, flower aficionados know the Madagascar periwinkle as a colorful, flowering plant popular for decorating patio flower pots. In its native tropics, however, the periwinkle’s uses extend beyond decorative. It has long appeared in folk medicine as an anti-diabetic drug, and in various places in the tropics, medicines made from periwinkle are still used.

In response to its reputation as an insulin substitute for diabetic patients, scientists began testing periwinkle in the 1950s. Two labs, one in Canada and one in the U.S., arrived at the same startling conclusion independently: extracts of the Madagascar periwinkle are extremely effective as anti-cancer drugs. The scientists of the two labs began studying periwinkle from two different angles, but when they realized they had both discovered anti-cancer properties, they pooled their knowledge and developed several of the most effective drugs known for treating several kinds of cancer.

Most survivors of leukemia owe their health to these scientists and their discovery of Madagascar periwinkle drugs. When used as a component of chemotherapy, drugs isolated from periwinkle offer dramatic results. To illustrate this point, in 1960, before the periwinkle drugs were available, a child with leukemia had one in five chances of remission. Today, a child suffering from the same disease has four in five chances of remission. Sales of vinblastine, the major drug derived from periwinkle, exceed $100 million.

**INDUSTRIAL PRODUCTS**

**Jojoba**
(*Simmondsia*)

Liquid wax lubricates machinery and withstands extreme pressure, making it an exceedingly important substance in industry, yet the means of obtaining adequate supplies poses a serious environmental problem. Unfortunately, liquid wax is extremely difficult to synthesize and the endangered sperm whale provides the only natural source of liquid wax. The demands of a world sustained almost entirely on industry clearly threaten a rapidly vanishing species of whales. However, jojoba may save the sperm whale while providing valuable oil.

Jojoba grows naturally in the arid regions of northern Mexico and southwestern U.S. The seeds contain 50% liquid wax, making it a treasure to those interested in isolating the oil. The pressed oil requires little refining and the protein-rich seed coats can be processed and used as a healthy cattle feed. The plants tolerate conditions in which other plants would wilt away, such as extreme temperatures and altitudes, salty soil, and very little water. A cash crop grown in an arid, desolate area wouldn’t deplete scarce water supplies. Hence, jojoba could provide solutions to several economic and environmental problems: farmers in underdeveloped, undernourished and infertile areas could grow viable cash crops, industry could have its valuable lubricant, and sperm whales could maintain a sizable population.

**Latex**
(*Asteraceae family*)

From tires to chewing gum, latex supplies us with material for familiar products. Fortunately, over 20 families of plants produce latex, satiating the enormous appetite for latex products. Among latex producing plants are those belonging to the family
Asteraceae (composites). Early interest in latex producing plants focused on Eucommia ulmoides, the only northern temperate tree with limited potential to make quality latex. Two industrially useful products develop from the coagulation of latex tapped directly from latex-producing trees: rubber and balata.

Rubber is probably the most famous product of latex because of its use in familiar consumer products. Mexican Aztecs discovered the elastic properties of rubber, forming bouncy balls out of the resilient substance. A French explorer sent a sample of the playthings back to Europe, whereupon he found pencil marks disappeared when rubbed by the substance, hence the name “rubber.” Various other rubber discoveries and inventions followed, and the waterproof raincoat and the Goodyear tire were born. The plant Hevea provides the largest source of rubber, though several other little-known plants also produce sufficient amounts of rubber, such as dandelions.

The plant that produces balata is commonly known as spurge nettle, though its botanic name is Manilkara bidentata. Balata is not as elastic or resilient as rubber, and its uses vary. The United States demands more balata than any other nation to produce chewing gum. Balata also acts as a good insulator, making it the prized material for insulating transoceanic cables. Other uses include golf-ball centers and dental fillings. Hence, the same substance that makes the sugary chewing gum that rots one’s teeth will fill the cavity left by it!

Oaks (Quercus)

The majestic beauty of oaks has captured the attention of people since ancient times. The durable wood provides an invaluable service not only as lumber, but as material for historically important (and sometimes obscure) products. As an example of the durability of oak, logs dumped in Britain by a spiteful Caesar’s Army in 55 B.C. were preserved in the British peat bogs. The ancient logs remain valuable material for decorative carving today!

English mariners profited from the waterproof wood of some English oaks. Balloon-like growths clog the veins of many oaks, preventing the passage of water from the exterior to the interior of the tree. Hence, English Oak became prized shipbuilding material. However, fungal infections weakened the trees while in the forest and continued to grow long after the tree was chopped down. This made for defective ships at times, and one angry sailor reportedly sank a ship by punching his fist through a fungally deteriorated wood plank.

On a more modern, yet obscure level, Chinese scientists searching for a material to absorb and withstand excessive heat decided to make heat shields on space re-entry vehicles out of oak.

**PALS**

To a Californian, palms evoke images of peacefully remote tropical islands or of Los Angeles. One species is native to California. However, few people appreciate the enormous economic significance of palms. In fact, palms may influence your lifestyle in ways you might not expect, supplying the shampoo for your morning shower and the margarine for your toast. Palms rank second among plant families in usefulness, the grass family (including corn and other grains) coming in first. A tremendous variety of products can be derived from palms. The famous coconut palm (Cocos nucifera), which has over 1000 uses, provides an excellent example of palm product diversity. In their native countries, palms provide sustenance for millions of people and contribute greatly to the economies of those countries. Cultivated on a large scale, palms boost the world’s economy. The usefulness of palms has led to their over-exploitation in the wild. Only a handful of countries have cultivated palms on plantations to prevent their destruction in the wild.

Because palms have such a wide variety of uses, they have a separate section in this brochure and their uses are divided into Food Products and Industrial Uses.

**FOOD PRODUCTS FROM PALMS**

Only 100 out of 2800 palms produce edible fruits. The two most economically important palms and perhaps the two most widely known, the coconut palm and the date palm (Phoenix dactylifera), produce edible fruit and help feed millions of people.

Cracking open the hard, brown exterior of the coconut reveals coconut “milk” encrusted by the white meat. Both of these interior treasures have several culinary uses: the meat may be eaten raw or cooked in over 100 different ways, or shredded and dried; the water can be sipped straight out of the nut or blended with the meat to make milk, cream or jam.

The fruit of the date palm appears occasionally in various Western confections, and is a staple in the diets of million of people elsewhere. Dates are rich in sugars, making them a high energy fruit. Like the coconut, they can be eaten fresh or dried. Dried dates usually appear in U.S. supermarkets because they can be stored for long periods of time. No wild date palms are known, as they have been cultivated for over 5000 years.

Another fruit-producing palm, the jelly palm
(Butia capitata), appears frequently in gardens because of its beautiful bluish-green fronds. However, few people outside of South American forests know that its yellow fruits are not only edible, but tasty, too!

Sugar and wine rank among the thousands of ways in which palms provide nutritional and economic sustenance for those who grow them. Palm sugar, known as jaggery, comes from crystallized sap and is extremely important to people in Asia, India, Burma, and Thailand. These countries produce and consume 100,000 tons of palm sugar each year. The sap from certain palms, including the Coconut Palm, also serve as the basis of alcoholic beverages such as arrack and toddy in South America and kava-kava in Polynesia. Unfortunately, the trees must be felled to obtain the sap. Upon distillation of the fermented sap, the isolated alcohol could also serve as an economically viable energy source, should the proper technology arise.

Among the various delicacies derived from the palm are the “hearts-of-palm” coveted by local peoples and Western chefs. Hearts-of-palm come from the apical bud of the palm tree positioned towards the top of the tree between the underdeveloped leaves and leaf bases. Unfortunately, the palm cannot grow without the apical bud and the entire tree must be chopped down to obtain the heart. The high demand for this favorite salad-topper has caused a major change in forest ecology where palms grow wild. The ecological threat caused by heart-of-palm hunters has inspired researchers to develop cultivation techniques of quick-growing palms for plantation production.

INDUSTRIAL USES

Several industrially valuable products come from palms. Oils and waxes with their high energy content and lubrication qualities make palms highly prized. The oil is pressed from the flesh of the dried fruit and passed on to serve in the production of such thing as margarine, soap, shampoo, cosmetics, dressings, fuels and lubricants.

Waxes found on the leaves, petioles and trunks of palms serve as a water-conserving mechanism for the plant. These waxes can tolerate an extreme amount of heat and are thus very useful. Products made from the wax of some palms include shoe polish, cosmetics, candles, floor wax, and records.

In tropical places, those indigenous to the area often construct their houses out of palms: the trunks supply material for major structural support and when polished provide handsome floorboards; the petioles offer minor structural support and the leaves with their thick waxy cuticle, provide a waterproof layer when thatched on the roof. Hours of sawing, weaving and thatching result in a cool, dry, well-ventilated home. Furniture to fill this tropical dream-home may also owe its origins to palms. The cane of some palms make excellent material for chairs or other various pieces of furniture. Export of cane furniture contributes significantly to the economies of countries in Southeast Asia.

All of these plants are represented in the UC Botanical Garden and appear along with several other ethnobotanical treasures in the ethnobotany brochure entitled “Plants in Human Affairs” available at the Visitor’s Center. Pick one up during your next visit and enjoy a self-guided ethnobotany tour through the garden!

----Jill Guenza, Lincoln Constance Intern

Pictured above are Jill Guenza and Lincoln Constance. Jill, a student of neurobiology at UC-Berkeley, was the Lincoln Constance Intern from July to December 1994.
Tropical Treasures, an educational tour at the UC Botanical Garden, was planned this fall. The tour was designed primarily for children as an introduction to the Garden’s tropical plant collection. The tour will impress upon children the intrinsic beauty and value of the tropics and the relevance of the rainforests to our daily lives. It will also emphasize the importance of conservation and the impact the tropics have on the global environment. The tour contains stories of many common products of tropical origins and several hands-on activities in which the children may participate. Below are a few excerpts from the tour.

Structural Adaptations

The limited supplies of water and nutrients combined with intense competition among different plant species has yielded special adaptive characteristics in tropical plants. Plants avoid competition by spacing themselves out in different locations in the forest, not only horizontally, but also vertically. With certain types of plants living on the ground, and some living in the lower levels of the canopy, and still others living at the highest levels of the canopy, the competition between plants is reduced. Plants also develop special structures which allow them to take advantage of their environments.

The Cecropia tree (Cecropia sp.) grows tall very quickly which allows it to compete for sunlight. Several adaptations of the Cecropia Tree enable it to grow tall quickly, and at the same time be able to stand up so tall. One is its hollow stems. The tree puts its energy for growing into height, instead of making heavy solid wood. It supports this height with structures called stilt roots. These are roots that grow above the base of the tree anchoring the tree down much like guy wires which support tall antennas.

Another group of plants change their shape and form to fit their current environment much like a caterpillar changing into a butterfly. These plants are the philodendrons and the Monstera. They begin their lives on the ground with large leaves and then slowly grow away from the sun. These plants slowly grow onto the base of trees where they climb up the trunks and again change form. The plant forms flat leaves flush against the trunk and grows up the trunk in this form. When these flat leaves reach a height where they get sunlight, the plant changes form once again into a plant with more conventional leaves.

When one thinks of the tropics, one usually thinks of it being very hot with lots of water. Plants have developed special structures to deal with all this rain. Some plants have special structures which collect water, while others have systems designed to get rid of water as quickly as possible.

Epiphytes live perched on other plants. Epiphytes must keep as much water as possible, because the root system cannot tap water from the ground. One epiphyte, Spanish Moss (Tillandsia sp.), is a stringy plant with silvery scales which trap and hold moisture. Epiphytic tank bromeliads have leaves arranged in an overlapping rosette which forms a cistern able to catch and store water. Tree frogs, mosquitoes, flatworms, snails, salamanders, and even crabs complete their life cycles in the tiny aquatic habitats provided by the cup-like interiors of bromeliads. One study found 250 animal species occurring in bromeliads. A group of birds called euphonias use bromeliads as nest sites! Many bromeliads also produce beautiful, brilliantly colored flowers which grow on a central spike. These flowers are usually bright red and attract pollinators.

Ceiba Tree

The trunk of the Ceiba Tree (Ceiba sp.) is covered with thorns which makes it difficult to eat the bark or for an animal to climb up the tree to eat its leaves. The thorns are even more dangerous than they first appear, because each is covered with lichens and various microbes and can cause infection easily if the thorn breaks the skin. Some plants also have spines or stiff hairs on their leaves that can be described as a “bed of nails” that sometimes impale caterpillars. Such sharply toothed leaves greatly reduce caterpillar grazing and when the teeth are experimentally removed, the caterpillars have a feast!

Ant and Acacia Co-Evolution

A story of co-evolution can be found in the relationship between an ant (Pseudomyrmex ferruginea) and the bull horn acacia (Acacia cornigera), so named because the tree has pairs of large hollow thorns on its stems. These thorns are where the ants make their home.

When the Acacia tree is little, a single queen ant digs into one of the thorns and begins a colony, which can get as big as 12,000 ants by the time the tree is mature. Ants walk up and down the tree “patrolling” the stem. They attack any other bugs, including beetles, caterpillars, or even other ants which land on or climb on the tree. The ants also help the tree by clipping any plants that begin to grow nearby or over the top. The ants act like the tree’s personal...
gardeners by removing bugs and trimming leaves which interfere with the plant’s growth. Removal of nearby vegetation also creates a fire break around the Acacia.

Why do the ants do this for the Acacia tree? One reason is that the ants have a place to live within the thorns, and they obtain food. The Acacia tree has two types of special food benefits. Small light-colored food bodies on the tips of leaflets are called Belitian bodies. The second type, extrafloral nectaries, produce nectar. These are located near the base of the leaf and leaflet stalks. So both sides win, the ants are the gardeners of the tree and in return the tree gives the ants food and a place to live.

Manihot

Many foods can be obtained from the tropical rain forest and one of the most important is manihot (Manihot esculenta), also known as: Yuca, Cassava, Tapioca, and Sagu. The Manihot plant is the lowland American tropics counterpart to the Andean highland plant, the potato. It is frequently the sole food in a village and a mainstay in the diet of many tropical residents year-round. It may be consumed boiled or ground and dried into a meal resembling corn meal. The young foliage can be consumed as a green or used as food for farm animals.

There are two general kinds of manihot: “sweet” and “bitter.” They differ in content and location of a cyanide poison. The plant produces this poison as a defense against insect attack.

The residents of the Amazon region cultivate manihot in large areas immediately surrounding their houses. The nutrient-poor soil makes it difficult to grow other food crops. The plant grows vigorously because of its deep roots which are able to reach deep subterranean nutrients. Before manihot is planted, most of the vegetation is cut down and burned. Manihot is then planted by sticking twigs or cuttings directly into the soil. The crop is allowed to grow for 8 -16 months and then the fleshy roots are harvested.

To prepare the plant to be eaten, the first step is to peel the roots, cut them into short pieces into a bowl of water, and then soak the pieces overnight. This dissolves some of the poison. Next, the roots are grated into a mash. The mash is then pounded through a tightly woven basket sieve to extract more of the poisonous liquid. This mash is stuffed into a nine foot long cylindrical wicker tube named "whola" after a local name for a snake. One end of the tube is attached by a loop onto a tall pole and at the other end, two or three people pull down on the tube squeezing the tube tightly which extracts more of the deadly juice. The juice is collected in a large pot, and then boiled until the remaining poison evaporates. The juice is now safe to consume and can be used as a sauce for meat. The mash is also now safe and can be eaten as such or made into a beer which is called "chicha de Yuca.”

The Manihot plant is better known in North America and Europe as tapioca which is prepared from manioc flour. To prepare tapioca “pearls,” manioc starch pellets are forced through a mesh and heated at controlled temperatures. This process causes swelling, gelatinization, and partial hydrolysis to sugar. It is from this that we can make tapioca pudding!

Curare

Indigenous people of the tropics are extremely knowledgeable of the thousands of plants and animals that live around them. They recognize vast numbers of plants and know about their medicinal or other special properties. One such South American compound is called curare and is made from several different plants.

There is no “recipe” for curare, but rather it is prepared differently depending on the region where it is made. Curare works by paralyzing the victim and eventually kills when paralysis reaches the respiratory muscles and the victim is no longer able to breathe.

To prepare curare, a concentrate of “bejuco de mavacure” is produced by finely shredding and boiling the bark of the Strychnos liana. This concentrate has a strong, bitter taste (curare is poisonous only if it enters the bloodstream, and not dangerous when taken orally). Several more plants are added to increase potency and body of the mixture. The mixture is boiled down to a black tar-like substance which is applied to arrows and darts.

Modern science has found a new use for this old poison. Scientists have discovered that curare works by blocking impulses from the brain to muscles, and with carefully administered doses, doctors can use a form of curare during surgical and diagnostic procedures when partial paralysis is needed. Curare also has been used to alleviate the symptoms of lockjaw, epilepsy and other muscular spasms.

Quinine

About 100 million people are affected by malaria at any one time, and approximately 1 million of them, mostly children, die each year. The symptoms, familiar throughout the tropics, include severe chills, fever, sweating, an enlarged and tender spleen, confusion, and great thirst.

The disease is caused by infection of the sporozoan Plasmodium, which is spread from person to person by mosquitoes of the genus Anopheles. When an Anopheles mosquito penetrates human skin to obtain
blood, it will also inject *Plasmodium* cells into the bloodstream. Once in the bloodstream, the parasites invade the red blood cells, dividing rapidly within them and causing them to become enlarged and ultimately to rupture. This event releases toxic substances throughout the body, bringing about the well-known cycle of fever and chill which repeats itself every 48 or 72 hours.

The disease may be brought under control by the person’s immune system or by drugs. One such drug is quinine, which is isolated from the bark of the South American *Cinchona* tree.

To obtain the quinine, the tree is beaten with a mallet to loosen the bark, and then the bark is peeled by hand with machete or knife. The peeled bark must then be dried quickly to prevent loss of the active ingredient. The fully dried bark is then sent to factories for final solvent extraction of the quinine, the active ingredient.

Scientists began noticing that people who had taken quinine against malaria had unusually healthy hearts. After reexamining the quinine which patients had taken for malaria, scientists noticed that there was another ingredient in the bark extract, quinidine, which helped regulate the heartbeat. Methods were developed to extract the quinidine from the bark, and produce it in mass quantities. Nature’s pharmacy has once again provided a practically unlimited supply of natural remedies. The bark of the *Cinchona* tree provides quinine to cure malaria and also quinidine which is now prescribed as an effective medication for patients with heart problems.

Oliver Pilhar, U.C. student

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**Pack Your Bags!**

**Namaqualand and the Cape Floral Kingdom**

The Friends of the Botanical Garden will sponsor a tour to South Africa August 17-September 2, 1996. The tour has been designed around the wildflower season when Namaqualand literally bursts into bloom. The group will also visit nature reserves and botanical gardens throughout western Cape Province. Dr. Robert Ornduff, former director and present curator of the U.C. Botanical Garden, will lead the tour.

For itinerary and information call GEOSTAR at 800-624-6633.

**Can You Help?**

The following plants, rare in commerce, are wanted by readers:

- *Melaleuca styphelioides*
- *Cytisus multiflorus*

If you can offer seeds or other propagating material on any of them, or know of a possible source, please contact: Mary Lynn Cox, 66 Eureka Avenue, Kensington, CA 94707.
CALENDAR OF EVENTS

FEBRUARY

PLANT CLINIC  Sat. Feb 4
Bring your sick plants to see Dr. Robert Raabe, UC Plant Pathologist, and his colleagues. First Saturday of the month, 9 am to noon. Meeting Room.

CHOCOLATE TASTING  Sat. Feb 11
Our popular Valentine event! Learn everything there is to know about our nation’s favorite sweet from Dr. Rudi Schmid, U.C. Berkeley plant scientist, and Russ Bianchi, a chocolate industry expert. Then compare many kinds of chocolate in a tasting. 1-4 pm. Reservation recommended. One member, $10; two members, $15. One nonmember $15; two nonmembers, $25. Meeting Room.

TEA FOR TWO  Sun. Feb 12
There is much to be known about tea, its background and lore. Explore this fascinating topic with Helen Gustafson, tea enthusiast and buyer for Chez Panisse. There will be several teas to taste! Reservation recommended. 3-5 pm. Members $10, nonmembers $15. Meeting Room.

CLIMBING THE GARDEN WALL  Sat. Feb 25
Vines make an elegant addition to the landscape, one most of us overlook. Jeanne Bliss, a gardener from Oxford, England, will enlighten you with a slide lecture on using vines to accent the vertical spaces in your garden. 10 am. Members $5, nonmembers $8. Meeting Room.

MARCH

PLANT CLINIC  Sat. Mar 4
Bring your sick plants to see Dr. Robert Raabe, UC Plant Pathologist, and his colleagues. First Saturday of the month, 9 am to noon. Meeting Room.

PEET’S COFFEE  Sun. Mar 5
Jim Reynolds, General Manager of Peet’s Coffee, Inc. will present a slide lecture on Berkeley’s favorite brew, followed by a tasting of several different types of coffee. 10 am -1 pm. Reservations recommended. $10 members, $15 nonmembers. Meeting Room.

We are always looking for Program suggestions!
Please give Nancy Swearengen, Education Assistant, a call at (510) 642-3352 if you have an idea, or if you are willing to volunteer at an event!

For further information on classes and events, call the Visitor Center, 642-3343. To register for classes, send checks to UC Botanical Garden. Two weeks advanced notice is necessary to accommodate individuals with special needs. No refunds the week before the class date unless class is cancelled. Pre-registration is suggested, as classes fill early.

The Garden is open every day of the year except Christmas from 9:00 am to 4:45 pm. Free public tours led by docents are given on Saturdays and Sundays at 1:30 pm. Admission to the Garden is free.
BOOK REVIEWS

What kind of books should be available in our Visitor Center? There are so many of you out there who come to the Garden for information, relaxation, renewal and joy. What would interest you? Are you looking for books about plants? Or do you want to know how to plan your own garden? Are you a hobbist collecting cacti and succulents?...penstemon?...orchids? Do you want something on plant exploration and discovery? A field guide? What about children and plants? These questions are asked, and answered, every day by the volunteers at the Visitor Center, the Garden staff (who make suggestions), and the gift and book buyers. We all enjoy the collaboration and discoveries which come with the job, and the challenge of displaying our wares in such a small space! Here are some of our recent and not so recent titles which, we hope, may interest you.

NEW BOOKS

CALIFORNIA WILDFIRE LANDSCAPING, by Maureen Gilmer; Taylor Pub. Co., Dallas, TX, c1994; illus; 164 pages; $10.95, paper.
Maureen Gilmer tells us that the California Dept. of Forestry believes that our state contains "the most severe wildfire conditions in the world", because of our urban-wildland interface conditions from development in grasslands, chaparral and forest areas. The recent severe wildfires in Berkeley-Oakland, Laguna Beach and Malibu are examples of this interface, and have made us all aware that we must do a better job of landscape management to protect our homes and communities from wildfires. CALIFORNIA WILDFIRE LANDSCAPING is a good comprehensive reference on the dynamics of wildfires and how to choose property not subject to fire, and how to insure it. There is advice on how to create a 'defensible space' around our homes in fire-prone areas, and how to make this space accessible to firefighters. There are instructions on how to store water so that it can be used in an emergency; what plants to select for designated safety zones around our homes; and how to get public and private assistance after fires occur. It includes the full text of Assembly Bill 337: The Very High Fire Hazard Severity Zones Law (the Bates Bill). Recommended by PACIFIC COAST NURSERYMAN, Oct. 1994.

THE GARDENS AT FILOLI, text by Timmy Gallagher, photographs by Christopher McMahon; Pomegranate Artbooks, c1994; 128 pages; $19.95, soft cover; $29.95, hardcover, available on request. Filoli is, for all of us, the great San Francisco Bay Area garden we visit in every season, and which we take delight and pride in showing foreign visitors. It is 'one of the last great estates with house and garden intact from a golden era of San Francisco's history', writes photographer Christopher McMahon. Timmy Gallagher, who started the docent program at Filoli, and who is a friend to many of us and a well-known member of local garden societies, tells us about the history of the 654-acre estate since the mansion was built in 1915. Because Filoli is composed of so many serene and beautiful 'garden rooms', this book is a good reference for gardeners looking for garden-planning ideas.

PLANTS OF THE SAN FRANCISCO BAY REGION: MENDOCINO TO MONTEREY, by Eugene M. Kozloff and Linda H. Beidelberg; Sagan Press, Pacific Grove, CA, c1994; 457 color pictures, 220 drawings; 448 pages; $29.95, soft cover. Includes 2,000 species of trees, shrubs, ferns, flowering plants and established exotics which appear in nine local counties. Plant key. (Linda Beidelberg was for many years a co-chair of the East Bay Chapter of the California Native Plant Soc. annual plant sale).

OF ADDITIONAL INTEREST

ITALIAN GARDENS OF THE RENAISSANCE, 5th ed., by J.C. Shepherd and G.A. Jellicoe; Princeton Architectural Press, NY, NY, c1993; illus; 92 pages; $55.00, hardcover. Reissued classic study of Italian gardens by two world-wide famous architects made when they were 5th year students at London's Architecture Assoc.

ITALIAN VILLAS AND THEIR GARDENS, by Edith Wharton, with pictures by Maxfield Parrish; Da Capo Paperback (Classical American Series In Art And Architecture); 270 pages; $16.95, paper.. Reprint of a 1904 classic by Edith Wharton, novelist and aunt of pioneer landscape architect Beatrix Jones Farrand.

ITALIAN GARDENS, by Charles A. Platt, essay by Keith N. Morgan; Timber Press Sagapre(Sagapress), Portland, OR, c1994; 74 black and white photos; 172 pages; $35.95, hardcover.
A new volume containing Charles A. Platt's 1894 epoch-making classic with an essay on its influence and importance by Keith N. Morgan.

AN ILLUSTRATED DICTIONARY OF CHINESE MEDICINAL HERBS, by Wee Yeow Chin & Hsuan Ke; CRC'S Pub., Sebastopol, CA; North Amer. ed.c1992; color photos; 184 pages; $32.95, hardcover.

CHINESE HERBAL MEDICINE, by Daniel P. Reid; Shambhala Pub., Inc., Boston, MA, c1987; color photos; drawings; 174 pages; $20.00, paper.
References on Chinese medicinal herbs are always available at the Visitor Center. Both books list medicinal plants and include the plant family, genus, species, common name, chinese character and use of these plants. CHINESE HERBAL MEDICINE contains a good historical background of chinese medicine.

Remeber, members of the Friends of UC Botanical Garden receive a 10% discount on purchases at the Visitor Center!

----Elly Bade
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IN HONOR OF
Gladys Eaton for her extraordinary service and dedication to the Garden and the Friends, from Mary Ricksen and Dr. Robert Ornduff.

Roger Raiche and Tom Chakas from Richard G. Turner, Jr.

IN MEMORY OF
Florence Edwards Higson from Howard and Susanne Jesson.

David Coronado from Martha and Manuel Coronado to be used toward the Mesoamerican section of the Garden.

Maggy Garrison from Jean Nunnally and Mrs. T.W. Ohlson to go to the California Native Area Endowment.

A bench has been donated in memory of Harry G. Bloomstein from his sister Carole Bloomstein.

A bench has been donated in memory of Rita R. Mandeville from Scott Mandeville.

A bench has been donated in memory of Arthur and Helen Bragg from Helen and Beau Breck and family, Mary and John Ricksen and family and the following family and friends:
Sally and Tom Adams
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Mary, John, Claire, and Kate Christian
Nancy and Hugh Ditzler
Gladys Eaton
Lib Hammond
Eleanor and Jack Higson
Marilyn and Bill Logan
Coleen and Rupert Ricksen
Susan and Larry Ricksen
Jane and Nelson Weller
Dr. and Mrs. Roger Westmont
Peter and Midge Zischke

SPECIAL PROJECTS
Elmo and Frances Morgan gave a gift to be used on the Main Entrance Improvement Project.

THE DOCTOR SAYS...

It may seem a little early to think about summer gardening, but a rainy night and a good seed catalog make a nice combination.

Last year, several counties had tomato trials to determine good performers, as well as good flavor. Unfortunately, under different temperature regimes, varieties will differ in a number of characteristics. Also, the time of sampling and irrigation schedules have an influence on the flavor. For example, if tomatoes are allowed to go dry, this tends to increase the solids and the sugar content. However, this also increases the tendency for blossom end rot which definitely should not be encouraged.

The results of the trials reported here were done in Santa Clara County and the warmer parts of Alameda County, so this information is not valid for all areas.

From one area, Sweet Chelsea was rated the overall best. Other varieties rated high were Early Girl, Supersteak, Bragger and Mr. Stripy. For a paste tomato, Viva Italia was very good and for small tomatoes, Sweet 100 was tops. In another area, Pineapple, Mr. Stripy, and Brandywine were rated high. Brandywine also rated high in another test but it is susceptible to Verticillium and Fusarium so unless growing it in uninfested soils, don't try it. For a yellow tomato, Caro Rich was very good and Green Grape, which is green when ripe, also rated high.

Perhaps the best approach is to get a copy of R.H. Shumways catalog called "Totally Tomatoes." It lists and describes 275 varieties from old timers to new hybrids. The address is P.O. Box 1626, Augusta, GA 30903.

When choosing varieties, try to select those that have a V and an F or FF in the code that goes with the name. This means resistance to Verticillium (V) and Fusarium (V or FF - the latter means resistance to both races of Fusarium). Other letters include N for resistance to nematodes, T for resistance to tobacco mosaic virus, A for resistance to Alternaria and St for resistance to Stemphyllium. The V is most important in much of California and F is next most important.

Another thing about tomatoes is that they are susceptible to spotted wilt virus. This virus does not damage plants too much, but does cause the fruits to be mottled with yellow blotches making them unsightly. Plants such as Aralia, calla, dahlia, tuberous begonia, and nasturtiums harbor this virus. Thrips transmit the virus so it is a good idea not to grow such plants near your vegetable garden. Lettuces are
quite susceptible and Cos or Romaine usually die if infected.

There is a lot of talk about recycling old Christmas trees. One might recycle theirs at home. Cut the branches off and spread them out or pile them to dry. When dry, shake or strip the needles and put them in the compost pile. Break small branches and put in boxes for kindling in the fireplace and the main stem can be cut and used the following year as a yule log.

Because of all the rain, the dormant spray for peach leaf curl control probably had been washed away. Peaches and nectarines probably will have to be sprayed again. Wait until later in the season, but do not wait so long that the buds have started to break. That's too late.

Be sure to prune your roses into dormancy and in doing so be sure to take off all the leaves and rake up all the leaves on the ground so that the rust and black spot life cycles can be broken.

----Dr. Robert Raabe, Associate Director

VOLUNTEER PROFILE...

JUNE FALKNER

Many of the volunteers at the Garden pursue more than one interest. June Falkner is one who has given an enormous amount to the Garden with her generous donations of time and skill.

June was born in England, and served in the WRENS (the women's service of the British Navy) during World War II where she handled ultra secret communications. During her servie, she spent 18 months in Sri Lanka, which she describes as fascinating. After the war, she married and lived for a year in Paris.

In 1954, with her husband, children aged three and five years, "two dogs and a sportscar," she arrived in Cincinnati, and has been in the United States ever since. The family moved to Berkeley in 1981, and June showed up at the Botanical Garden to work as a volunteer in January 1982, propagating trees and shrubs. She says she was "a good backyard gardener," but has inevitably learned a tremendous amount in her "on-the-job-training" as a Volunteer Propagator. So much so, in fact, that last year she started a small specialty nursery business!

Almost at once, she joined forces with another longtime Garden volunteer, Elly Bade, and over the years they organized and presented symposia, which brought many well known garden speakers, writers, designers and plantsmen together under the auspices of the Friends of the Botanical Garden. Over the years, there were ten symposia!

In 1986, June was invited to join the Board of the Friends. She branched out to the Program Committee, and further, to planning the Friends trips abroad. She planned and organized six very successful Friends-sponsored trips, to the gardens of Ireland, Portugal, France, Italy and Costa Rica.

In 1987, when the Friends undertook the management of the Visitor Center, June was there. Her task was to begin to build the book collection, which she did with the same dedication she gives to everything else.

Over the years June's has been an almost daily presence at the Garden as she has gone about her many projects in support of the Garden and the Friends. Now, she has decided to relocate to the Seattle area to be near her daughter, and to pursue another dream, building Kingswood Nursery, her own specialty nursery of mainly small, unusual plants! Thank you for everything, June! We wish you all the best in your new endeavors!

----Nancy Swearengen

June Falkner
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Plants are for sale at the Visitor Center all year! Call 642-3343