



FRIENDS OF CITY OF ROCKS NEWSLETTER
(Vol. 5, No. 1, Feb. 2021)
MISSION STATEMENT

The purpose of the Friends of City of Rocks State Park, Inc. (website: <http://friendsofcityofrocks.org>; e-mail address: friends@friendsofcityofrocks.org) is to help support the New Mexico State Parks in the enrichment of the park area. Specifically, the Friends aim to enhance, preserve and promote park use, to participate in nature as responsible stewards of the earth, to create an awareness of the wonder, fragility and importance of the park, to develop and improve existing education/interpretive programs, to develop and improve public awareness of the park, and to encourage public participation and/or membership in the Friends group.

BECOME A MEMBER OF THE FRIENDS!

Interested in helping out City of Rocks State Park? Consider joining the Friends. Typical Friends activities include highway cleanup, cutting and splitting firewood for sale to park campers, operation of a gift shop in the park Visitor Center, fund-raising, etc. To join, a) complete and send in the membership application form at the end of this newsletter, OR b) download, complete and submit a membership application from the Friends website (see above). **NOTE: If you are already a member of the Friends, it is time to renew your membership! You can do so using the same form mentioned above.**

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A Message from Park Manager Gabriel (“Gabe”) Medrano

City of Rock is currently open Thursday - Sunday 7 am - 4 pm for day use only. Only NM residents are allowed in the park at this time. The main loop of the park is now open. North Pegasus remains closed. The current public health order is due to expire on February 26th after this date we may open for camping by reservation only. Park staff continue to work around the park cleaning, sites trimming trees and clearing up the trails.

CACTI AT THE CITY OF ROCKS

by Edwin Leuck

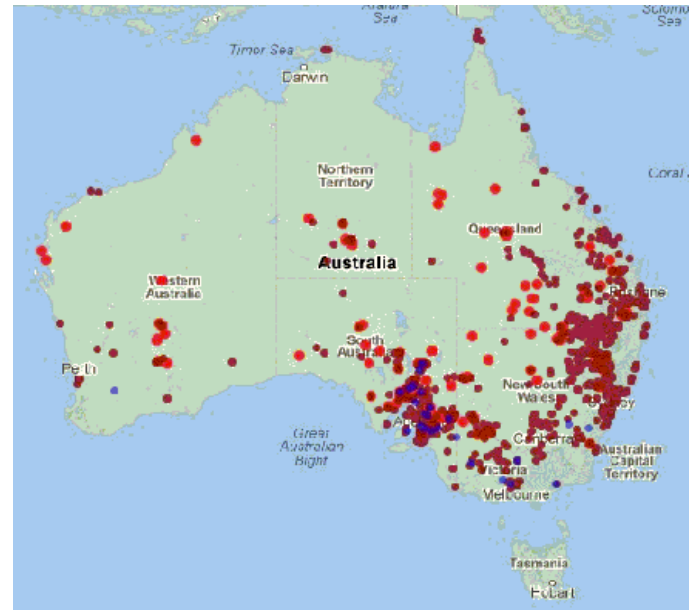
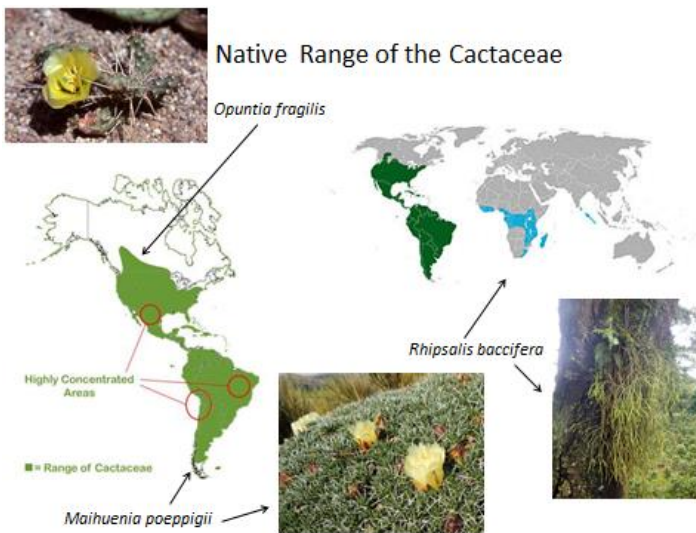
The cacti are very often conspicuous elements of a flora, since they are evergreen perennials and thus highly visible in any season. The Chihuahuan Desert around the City of Rocks State Park contains at least fifteen species of cacti, a few more if Table Mountain is included. The Park itself contains, either native on-site or planted, about this many species. Six species are currently within the Botanical Garden itself.

The first cacti described were collected from the Caribbean. Columbus himself brought back a specimen of “*Echinomelocactus*” collected from the coast of Jamaica to cultivate in Europe. By 1753, Linnaeus was able to include fifteen species of cacti (all placed in the genus *Cactus*) in his *Species Plantarum*. Newly described genera and their species were placed in the new family Cactaceae by de Jussieu in 1789. The cactus family

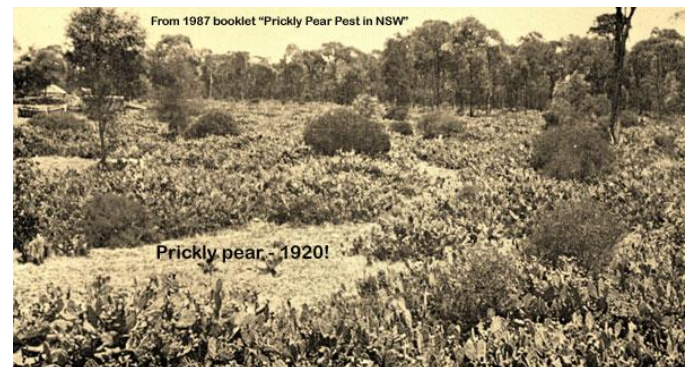
(Cactaceae) now includes about 1500 species dispersed among 125 genera.

With a single exception, the native range of the cactus family is only in the New World, North and South America. There is a prickly pear (*Opuntia fragilis*) that occurs as far north as the American plains bison went in the grasslands of western Canada. This small cactus reaches 56 degrees N in British Columbia. Towards the southern end of South America, one cactus genus (*Maihuenia*) is a mat-forming cushion plant high in the southern Andes Mountains of Chile and Argentina. It is buried under snow for several months per year. The sole exception to the New World-only distribution is a tropical epiphyte (*Rhipsalis baccifera*), that occurs as far north as southern Florida and throughout central and eastern South America. It is established across the rain forest belts of Africa all the way to Sri Lanka. This could have been transported by migratory birds (internally or on feet, as the small fruits are very mucilaginous and sticky), or sailors in the 1500s and 1600s. Once in Africa birds would certainly be the vector for dispersal.

In Australia some 15,000 square MILES had been rendered unusable for any purpose by 1920.



“Wait” you say. “I saw prickly pears at the Acropolis.” Yes you did- prickly pears, especially, have been introduced to southern Europe and eastern Africa and have become invasive. The worst case was the deliberate introduction of up to twenty species of large upright prickly pears from both North and South America into Australia in the mid and late 1800s for “living fence” and a commercial product cochineal dye from insects that feed on prickly pear. (You can find a similar species on our prickly pears and chollas in this region. Look for white fluff, scrape some off and squish a few bugs and you will see plenty of crimson red.)



Today we should expect something like this to happen, as there were no large animals capable of grazing upon prickly pears and no insect pests or diseases indigenous. The Australian government undertook a massive project to find a biological control. The answer came from an Argentinian moth, *Cactoblastis cactorum*. The larvae of this moth burrow into the pads and feed voraciously. In addition, when the rainy season does occur, the wet pads full of

holes are subject to fungal attack. To continue the thread of invasive species damage, the moth was later introduced to Caribbean Islands to control prickly pears, themselves introduced and spreading. Now the moth has crossed into Florida, destroying native prickly pears along the Gulf Coast, and is currently moving west into Texas.



Pads of the large shrubby prickly pears are still used commonly as cattle feed in Mexico, after some preparation to remove or at least minimize spines. Nopalitos (cleaned and diced pads) are available widely, such as in the produce department of WalMart in Silver City.



They are used widely in green chile dishes and burritos. Prickly pear fruits are widely consumed in Mexico, and there are several varieties, much like apples. The Tohono O'Odham of central and southern Arizona traditionally harvest lots of saguaro cactus (*Carnegieia gigantea*) fruits. Luther Burbank, deserving of fame for developing many fruit varieties in plums, peaches, nectarines and many more, worked with only moderate success to develop spineless versions of the large shrubby prickly pear species. He was going to vegetate the deserts of the world with a crop useful for its pads for livestock and large juicy edible fruits. However, the spineless nature of many plants did not hold under harsher conditions, and the

large size and rapid growth only happens with adequate water. His creations were also not very cold-hardy, greatly restricting where they could be grown.

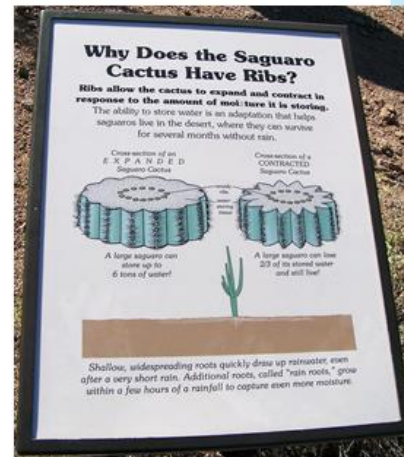
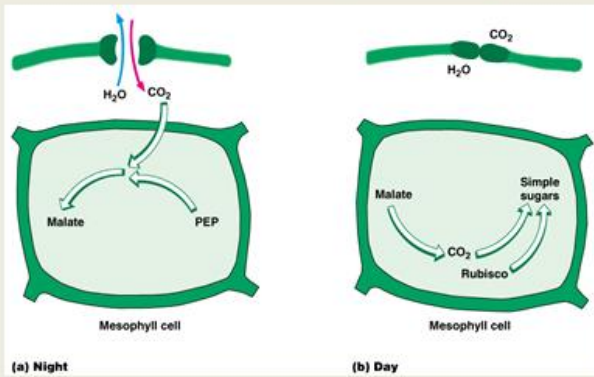


Cacti seem to have evolved as a distinct family 30-35 million years ago. There is no fossil record at all, as even today very few produce ligneous wood. Their closest relatives appear to be succulents in the Portulacaceae or its derivatives, and the Didieriaceae of Madagascar. One trait in common with these plants involves the physical mechanisms and pathways of photosynthesis. All plants can only manufacture sugars (and thus everything else-something plants can do that animals cannot) from the relatively rare carbon dioxide molecules in the atmosphere. While oxygen levels are around 20% in air (2,000 parts in 10,000), CO₂ levels in the atmosphere are only around 0.04% (4 parts in 10,000). Carbon dioxide enters by simple diffusion through the stomata, pores primarily in the leaves that can be opened and closed. For most plants, it is most efficient to input carbon dioxide in the daytime, when the light-dependent (energy-producing) reactions of photosynthesis take place, maximizing subsequent glucose production. The major drawback of this strategy is that water loss through the stomata is much

greater in the warmer temperatures and sunlight of daytime. Most plants close stomata at night when gas exchange is less important. In grasslands and deserts, however, water retention is more important. Cacti open their stomata at night, when water stress is less, and close them in daytime, conserving water but restricting carbon acquisition. To partially compensate, in nighttime they capture atmospheric carbon dioxide, producing and store smaller carbon-containing molecules. These molecules are then available for sugar production in daytime when light is available for energy production. This reverse opening of stomata and sugar metabolism is referred to as CAM (Crassulacean Acid Metabolism) photosynthesis. Lacking persistent leaves, the stomata in cacti are in the surface of the stems. The prickly pears and chollas alone have small green leaves with new growth that are soon shed (caduceous leaves).



CAM Photosynthesis



Desert Botanical Garden, Phoenix AZ



What else makes a cactus a cactus?

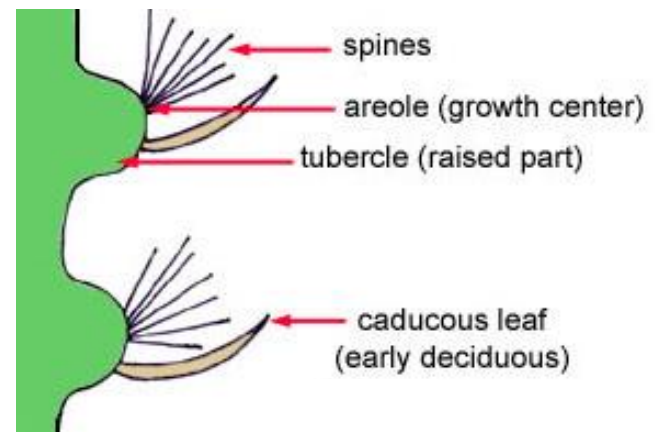
Family Characteristics

- Succulence/ stems expand and contract
- Leaves replaced by perennial spines
- Waxy cuticle on the epidermis
- CAM photosynthesis
- Areole anatomy (twin meristems)
- Flowers with inferior ovaries, tepaloid perianth, lots of stamens
- Betalain floral pigments (no blues, purple: red/pink/yellow/violet/white)
- $n = 11$ (base chromosome number)



Obvious are the succulent (fleshy), mostly cylindrical stems that store water efficiently. These expand and contract with water availability. To minimize the surface-area- to volume ratio (being a cylinder) means less area for photosynthesis and slower growth even if conditions are good. The flattened pads of prickly pears are less efficient at preventing water loss but have more surface area for photosynthesis.

Rigid perennial spines are present in nearly all cacti. The spines are produced from modified growth regions (meristems) on cactus stems called areoles. These areoles also may produce branches or flowers.

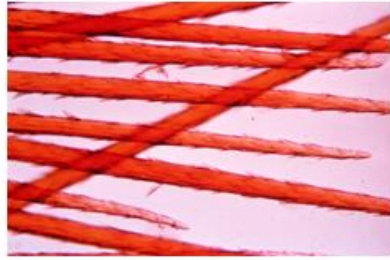


The spines themselves are considered modified leaves, unlike the prickles of a rose bush or a mesquite thorn, which are developmentally stem tissue. They serve at least two primary functions. Obvious is that spines minimize herbivores eating the juicy stems. The spines deter both larger herbivores as well as rodents that would eat all of the seedlings and young plants in many cases. In our area, stems of many plants that swell too much with

excessive water uptake expose naked stem to the packrats and are often eaten.



Spines are modified leaves, not stem tissue as are prickles or thorns, and arise from axillary meristems.



Glochids of the prickly pears have recurved barbs.



A second function of the spines is to provide shade to the stems themselves, reducing heat build-up as the sun changes the angles of light strike. In some cases, the spines are hair-like and fuzzy.



Cylindropuntia spinosior young plant

Spines develop longer and thicker in plants in full sun, fewer and thinner in partially shaded situations.

Many cacti have large and conspicuous flowers. These have an inferior ovary (petals attached above the ovary), and the very numerous sepals and petals intergrade in shape and color (tepals). There are lots of stamens. The whole family produces only betalain floral pigments. Flowers may be white, red, yellow, pink, or violet – but there are no true blue pigments manufactured. All cacti have a base number of chromosomes of 11 ($2n=22$). Many species have multiple sets of chromosomes, as many as $2n=66$.

Flowers may last a single day (or night) or be open and functional for pollination two or three days. Diurnal flowers may or may not close at night.

To minimize water loss, the stems are covered by a waxy waterproof cuticle. The stomata are not covered by cuticle, and open at night and not in the daytime.

Most conspicuous in this area are the prickly pear cacti. These all have flattened pads, providing large surface areas for photosynthesis but also larger areas for water loss. Many noticeably wrinkle and shrink during droughts. Most species are amply protected by spines. Prickly pears also have clusters of glochids at the base of the spine clusters. These tiny spines have recurved barbs on them, making them very difficult to extract from skin.



yellow with red centers. Fruits are juicy and red-purple. Plants may be found in shade or full sun.



Anson, TX

Opuntia phaeacantha

Silver City, NM



- Long, at least partly brown spines, mostly apical
- Hexaploid (2n=66)
- About 3 pads high before falling over and rooting
- Flowers yellow w/ red centers
- Fruits dark red/purple



Silver City, NM

The largest and most conspicuous prickly pear in our area, and also in the Botanical Garden, is *Opuntia engelmannii*, Engelmann's Prickly Pear. George Engelmann, a physician in St. Louis, funded and processed many plant collections from army expeditions. He described new species in the American southwest and wrote *Synopsis of the Cactaceae of the United States*. Engelmann's Prickly Pear is large, upright, and highly branched. This plant may grow to eight feet tall and broader than that. Pads have thick chalky-white spines, deflexed (downward-pointing), on at least the distal half of the pads. The pads themselves are generally longer than broad, and may be a foot or more in length. The pads typically display huge numbers of longish brown glochids at the ends. Older large plants will seem to have multiple branches from the base as opposed to a single trunk, as the heavy branches sag to the ground. Flowers are generally numerous along the apical ends

Cholla cacti do not have glochids, but have these barbs on the spines themselves. Prickly pear flowers generally last only a single day, and the yellowish flowers fade to pinkish as the day progresses.

The most widespread of the prickly pears in southwest New Mexico is *Opuntia phaeacantha*. It is common from the higher mountains in the area into lower flat desert. This prickly pear is seldom more than three pads tall before falling over and rooting. These often form large clumps. The 1 ½" spines are mostly in the upper 1/3 of the pads. Most spines are multi-colored, with some brown or purple banding. Flowers are a bright

of the pads. The bright yellow flowers last only a single day and fade later in the day. The generally persistent tepals (petals and sepals that intergrade in shape and color) may remain on the developing ovaries and show pink. This is the most common big prickly pear across Texas, and is common throughout Arizona. In New Mexico it is restricted to the southern deserts.



Similar to Engelmann's Prickly Pear is *Opuntia chlorotica*, sometimes called Pancake Prickly Pear. The blueish-green pads are very uniform in size and are very much round. Spines are generally bright yellow and deflexed, occurring over the whole pad. As in Engelmann's Prickly Pear, the flowers are yellow, but the outside midrib on the tepals is often reddish. The plants may be as much as 8 feet tall and older plants show a definite single trunk. The range is from our area west through much of Arizona. The species is diploid ($2n=22$), very different from the hexaploid ($2n=66$) *Opuntia engelmannii*.



Opuntia tortispina is a dry grassland prickly pear favored by overgrazing that is low, creeping and spreading. Almost all areoles on plants bear long, somewhat twisted white spines. Flowers are yellow with reddish centers. The distribution is mostly east of this area up through the western Great Plains north into Nebraska. It appears to be a hybrid of the fleshy-rooted, few-spined *Opuntia macrorhiza* and *Opuntia polyacantha*, which ranges well into Canada.



Opuntia macrorhiza is also in the park. The plants are fleshy-rooted, with only a few apical spines on the smallish, dull-colored, often wrinkled pads. They may form patches. There are tufts of pale yellow glochids. Flowers are generally yellow with reddish bases: if the flowers are entirely red and the plants are small it is often called *Opuntia pottsii*.





A very conspicuous plant is the prickly pear *Opuntia basilaris*. It forms upright clumps to 3 feet tall, is essentially lacking spines, and produces a multitude of bright magenta flowers. Its native US range is southeastern California.



Opuntia linguiformis, or *Opuntia lindheimeri* var. *linguiformis*, is an unusual prickly pear with very elongate

stem segments. This has been a favorite plant for landscaping in southern regions. There are only 0-3 spines per areole. The spines are yellow, aging to blackish. Flowers are a bright yellow. These plants may be over six feet tall. There are few native populations, in south-central Texas, central Arizona, and west Texas south of the Guadalupe Mountains.



Opuntia macrocentra (just outside of the Botanical Garden) is almost spineless and is upright with rounded pads. The plant is usually rather purple in winter or under water stress. It has yellow flowers without any red. It is native but relatively uncommon in southern New Mexico and adjacent parts of Texas and Arizona.



tubercles that are crowded on the joint. This leaves the joints looking very much spinier than *C. imbricata*. The latter plant may grow as much as ten feet tall, while the former usually tops out at about 4 feet. Both have bright purple flowers and yellow fruits. The fruits are often persistent for several years. Cattle seldom mess with these plants, so a heavily grazed pasture may be quite full of them.

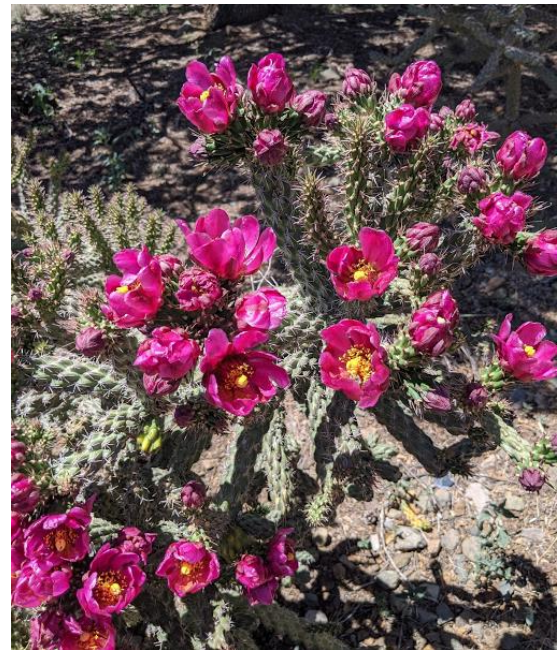


Cylindropuntia imbricata



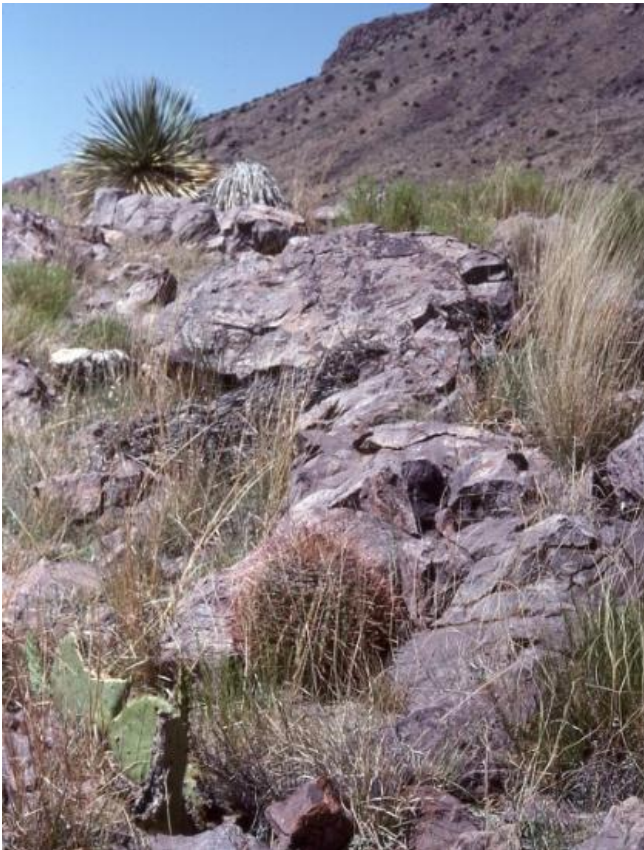
Cylindropuntia spinosior

There are two common chollas in the southern half of New Mexico, either one referred to as cane cholla or walkingstick cholla. Cholla cacti are upright, with cylindrical jointed stems. Each joint also has raised tubercles on it, from which the spines and flowers emanate. The spines themselves have minute recurved barbs upon them, making them very difficult to extract from skin. These plants leave very distinct skeletons behind. These often end up in crafts or as (weak) walking sticks, with a hollow core and elongate diamond-shaped holes on the sides. *Cylindropuntia imbricata* is widely ranging from central Texas west through much of New Mexico and north nearly to Colorado Springs. The more southern *Cylindropuntia spinosior* is the more common in our area and southern Arizona. Examination of joints will show that *C. imbricata* has long (20-50 mm) widely spaced tubercles, while *C. spinosior* has much shorter (5-15 mm)



Cylindropuntia spinosior
Silver City, NM

The large barrel cactus of west Texas and southern New Mexico, planted in the Botanical Garden, is *Ferocactus wislizeni*, or Fishhook Barrel Cactus. The plant is named after another botanical explorer, the German-born American MD Frederick Wislizenus. It is native as close as the Florida Mountains below Deming and up the mountains along the Rio Grande as far as Rincon. It may grow to three feet or more in height and two feet in diameter. The flowers are yellow to red and borne in a ring on the top of the plant every summer. Fruits are bright yellow and contain hundreds of seeds each. Few escape the birds and rodents of the desert. The spines are strongly curved and usually with horizontal ribbing.



There is a single representative of the hedgehog cacti, genus *Echinocereus*, growing in the desert grasslands in the area. This is Fendler's Hedgehog Cactus, *Echinocereus fendleri*. Augustus Fendler was an avid plant collector, working with George Engelmann and accompanying several expeditions in the 1840s and 1850s. This species was described from

the Mexican Boundary Expedition, which occurred after the Mexican-American War to find out what it was that the United States had won. Fendler's Hedgehog Cactus is a cylindrical plant with vertical ribs as much as ten inches in height. There are spines emanating from tubercles on those ribs. Usually there is a single central spine projecting out at a right angle to the stem. This is a very widespread grassland plant, into the pinyon-juniper zone, that is seldom noticed when not in flower. It tends to not be in discrete populations but scattered. The flowers, often several per plant, are three inches across and a bright magenta. They reopen for three or four days.



The remaining three cacti of the Park are not within the Botanical Garden at present, and would be very difficult to find. All are very short and globose, with a significant portion of the plant below ground. The most common is the most above ground plant, *Coryphantha* (sometimes *Escobaria*) *vivipara*. This has an enormous range in mountains and grasslands mostly east of the Continental Divide from Alberta, Canada, down through central Texas. It also is found through central Arizona. As one might expect for such a wide-ranging species, there is considerable variation in vegetative and floral anatomy, and many varieties have been named. This is the one plant that, if you were to go somewhere to look for cacti, that you would probably find. When swollen with water it may be up to six inches tall and three inches across. The flowers are usually a hot pink, with narrow petals. The fruit is comparatively large, green, and buried under spines until maturity. The plant has elongate tubercles emanating from the globose stem, with spines at the tips of them. Each tubercle in *Coryphantha* has a groove on the upper surface.





There are two plants in the genus *Mammillaria* that may be found. *Mammillaria heyderi* is a largely subterranean plant with only the round tuberculate top protruding from the ground- IF it is well-hydrated. Otherwise it may be flat with the soil surface. It may produce a full single ring of small white flowers in early summer. The fruits, narrow and elongate, turn red and protrude from the surface in fall and winter. This may be the best chance to locate plants in vegetation or even open ground.

Mammillaria heyderi



Mangum, OK



Refugio Co., TX



Refugio Co., TX

Mammillaria wrightii (Wright's Pincushion Cactus) is even more reclusive. Charles Wright was a plant collector, largely supplying Harvard's Asa Gray, who was the surveyor and botanist on the U.S.-Mexican Boundary Survey. It seems to have a southwestern and south-central New Mexico distribution, but seems to never occur in recognizable colonies. When swollen, it may be two-three inches across but only one inch above ground. Spines are divided into two groups. Radial spines radiate parallel to the stems. Central spines often project outward. In this species, there are 1-4 central spines, at least two of which are hooked.

COYOTES

by Tim Geddes

The name coyote is from the Aztec coyotl. Other names are prairie wolf, song dog, brush wolf, or just yote. The scientific name *Canis latrans* means howling dog. The Family Canis gets its name from the fourth and largest premolar on the lower jaw, the carnassial. These teeth are for tearing flesh. The Order that coyotes are in is Carnivora from the Latin *carnis* for flesh.

Coyote diets include vegetable matter as well as mice, rabbits, deer, and carrion. Food is based on availability. They usually hunt at night in pairs or family groups. Their home range covers ten to twenty miles and takes ten to fourteen days to make the circuit. Coyotes mark their territory with scent posts and their sense of smell is acute.

Coyotes range in size from thirty to thirty-seven inches in length with another sixteen inches of tail. They stand about twenty inches at the shoulder and weigh twenty to fifty pounds. Their grey-brown fur has little or no value on the fur market.



Flowers are white, and the fruits are seemingly large for such a diminutive cactus, looking like small grapes $\frac{3}{4}$ inch long and $\frac{1}{2}$ inch wide, and green. Much of the year this plant would be flat with or even below the soil surface



[https://en.wikipedia.org/wiki/Coyote#/media/File:Howl_\(cropped\).jpg](https://en.wikipedia.org/wiki/Coyote#/media/File:Howl_(cropped).jpg)

Coyotes mate for life and the females are in estrus in February and March. Sometimes a male coyote will mate with a domestic dog and the hybrid is known as a coy-dog. Typically, coyotes kill dogs. A den is used for the young that contains no bedding but is kept clean. After sixty days of gestation four- or five-blind pups are born. The record litter is nineteen. The eyes open in fourteen days. After the young are weaned, they are fed regurgitated food. Both parents help in this. After eight to nine weeks the pups start to hunt with their parents. The young reach sexual maturity in two years and may live ten or twelve years.

https://en.wikipedia.org/wiki/Coyote#/media/File:Gpa_bill_coyote_pups_3.jpg

Coyotes suffer from rabies, distemper, and mange. They endure tapeworms, roundworms, and hookworms. Being canines, they have fleas. Man is their greatest enemy. Ranchers and government control men wage war on coyotes with cyanide guns, strychnine, and 1080 poison.

In spite of all that is against them coyotes are a very successful species. Traditionally a creature of the western deserts and prairies they have expanded their range into the east. The howl of the coyote is a true sound of Nature and it looks like coyotes will be with us many years to come.

**TINY TREASURES IN A WINDSWEPT
BARREN
by Eric Head**

The Symposium program read, “Fieldtrips: Birds of City of Rocks State Park (Cienega Trail).” I thought, “Great! I have heard about how spectacular City of Rocks is and I haven’t been out there

yet - and I love birding!” I had moved to Silver City just a month earlier while putting the final touches on my master’s thesis in geology. Covid was just another weird story rumbling around out of Seattle.

A little background on me: I grew up in the Columbia River Gorge, traveled the world in the Army after high school, spent a few years working on boats and living the Jimmy Buffet life in Key Largo, then pursuing a degree in geology when the economy fell apart in 2007. I was just finishing up grad school, researching sediment transport by raft in the Colorado River in Canyonlands National Park, when I found myself at the Cienega Trail trailhead. I have to be honest: I was underwhelmed.

In front of me were gently rolling hills covered in sparse grasses and a few shrubs. There were a few small purplish mountains far off in the distance. The words that came to my mind first were “windswept and barren.” Windswept turned out to be apt – always make sure to have adequate clothing in those wide open spaces! Barren, as our guides Karen and Bill would make clear, was a gross misinterpretation of the terrain. On the particular day we were out, we did not see too many birds. But Karen explained where to find a wide variety of species and I saw my first Vermillion Flycatcher that day. Bill pointed out the vast diversity of plants that call these plains home. And then there were the rocks.

The strange and wonderful formations of the Kneeling Nun Tuff that give City of Rocks its name are nowhere to be found on the Cienega Trail. They are obscured by a small ridge of gently rolling hills to the north of the trail. But when one looks down at the pebbles and cobbles at your feet, you are presented with a stunning array of beautiful and interesting rocks in a kaleidoscope of colors and textures! Just as with the birds and plants, when you look close, whole new worlds open up to you on the Cienega Trail.

Zooming out to look at this area and how this particular bunch of rocks found their way here, you have to imagine what this



Figure 1: Cienega Trail agates.

place looked like in ancient times past. 35 million years ago the mountains surrounding City of Rocks would have been much higher and steeper. The intense volcanism that created the otherworldly tuff formations we all love climbing on also created tall volcanic mountains and great tectonic faults. It also brought many different kinds of much older rock to the surface while uplifting the entire region. Over time,

particularly in the last two million years while the ice age came and went, erosion has shortened and rounded many of the mountains. As a result, a great multitude of different rocks have been rolled downhill or washed on to the gentle hills we see today. In addition, very old bedrock layers of volcanic rhyolites that are tens of millions of years old, and even older (~300 million year old) marine sediment derived limestones, have been exposed by the uplift and subsequent erosion in the area.

Coming back to the trail, the first thing that caught my eye was shiny flecks



Figure 2: Native copper in Dacite glinting in the sun.

glinting at me in the sun. A closer look revealed very small flecks of native copper* shining brightly. It was nestled among some tiny milky colored quartz crystals and blocky tan feldspar crystals in a volcanic rock called dacite (please recall that I studied river sediments and not 40 million year old volcanic rocks – my rock ID is pretty good, but I sometimes mix up my tholietic basaltic andesites with my foid-bearing latites so

please bear with me!). As we moved down the trail there was a great deal of the copper bearing dacite. This was a great treat for me – I have never been anywhere that native metals are this abundant out in the open!

The next thing I noticed was the wide variety of agates to be found. I have been rock hounding agates for 15 years, and this site is rich with beautiful and unique varieties including a warm root beer brown variety in great numbers and several very nice banded agates. Now that my eyes had been adjusted to rock discovery mode, I started finding new and interesting finds everywhere . . .

A handsome striped maroon quartzite; pinkish orange banded sandstones; dark basalts with big white feldspar crystals and tiny green olivine crystals; green copper minerals (probably malachite or azurite) encrusted on white chert; bright red chunks of scoria full of vesicles (holes); a strange metamorphic rock with black and white swirls all through it; and pink tuffs similar in composition to those fantastical bulbous arrangements the park is famous for but here in fields of flat, broken slabs.

You may recall that I mentioned limestone that was hundreds of millions of years old. This ancient marine sea floor can be found outcropping for about 50 feet roughly halfway between the trail head and the cienega boardwalk on the south side of the trail. Small chunks of it can be found on the north leg of the trail about $\frac{3}{4}$ of the way between the trail head

and the boardwalk – just before the trail flattens out near the cienega. Most of it is massive limestone, but after carefully searching for a few minutes I was able to find crinoid fossils (commonly called sea lilies or feather stars) and a strange fossil that I still cannot identify and has stumped quite a few of my geology friends!

After the Cienega Trail hike, I visited the main section of City of Rocks State Park. Truth be told, after the multitude of tiny treasures around every corner in the “windswept barrens,” it didn’t take very long before my mind began wandering back there while still walking through the picturesque statues of the so called “main attraction.”

***It is illegal to collect rocks from City of Rocks State Park. They are for observing and admiring in place only.**



Figure 3: Strange fossil found along trail. Does anyone know what this is?

Thanks to William “Bill” Norris for introducing me to some wonderful people in the scientific community here and for the opportunity to write for this wonderful newsletter. Also to Heather Castello for helping make it readable.

FERNS OF THE CITY OF ROCKS

by Russ Kleinman

When people think of ferns, visions of lush plants in moist tropical highlands living in exotic destinations come to mind. Some of tropical ferns can grow nearly 50 feet tall — the tree ferns of tropical America, New Zealand, and southeast Asia come to mind. In the eastern U.S., it is not difficult to find ferns that grow to the relatively paltry height of 2-3 feet tall alongside trails.



Figure 1. Fairy Swords (*Myriopteris lindheimeri*) at the campgrounds at City of Rocks with the long underground stem running horizontally in the crevice and the many aerial fronds poking out

Now let me focus your imagination back onto the southwest desert grasslands and volcanic tuff that make up the City of

Rocks State Park. There are no 50 foot tall tree ferns here, and no lush 3 foot tall stands of Lady Fern. These larger ferns are unable to withstand to the hot, dry climate and frequent grassland fires that characterize the lower elevations of southwest New Mexico.



Figure 2. Appearance of Fairy Swords (*Myriopteris lindheimeri*) City of Rocks during the dry season.

Well, there ARE ferns at the City of Rocks, but you have to look down and not up to see them. Their leaves, also known as fronds, only grow a few inches tall. The underground horizontal stems from which these leaves arise hide in shaded crevices in the tuff and under the north side of some of the large boulders that make up the notable landscape here (Figure 1). Precious moisture persists longer in these protected places. Hidden in this way, ferns are less susceptible to the searing hot temperatures in the summertime and the freezing cold in our winters. If a wildfire comes through, only the above ground leaves burn away while

the protected underground stem and roots regrow new leaves quickly.

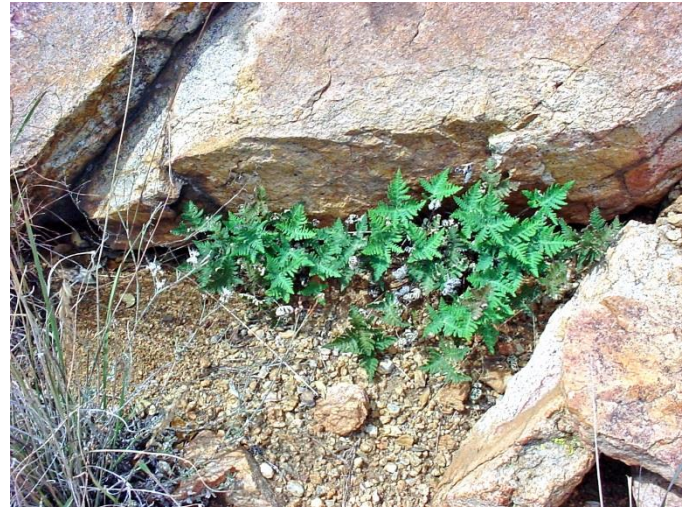


Figure 3. Star Cloak Fern (*Notholaena standleyi*) after a good wetting rain.

If you look with a magnifying glass or hand lens at the bottom side of fronds of the ferns in the genus *Myriopteris* found at the City of Rocks, you will notice that they have brownish scales coating the veins. At the base of the scales are special areas through which rainwater is directly absorbed into the frond. The fronds curl over as they dry out. This exposes their scaly undersurfaces to enable rapid water absorption (Figure 2). In this way, rainwater is absorbed in just a few hours into the fern rather than waiting up to five days for root uptake.



Figure 4. Star Cloak Fern (*Notholaena standleyi*) at City of Rocks during the dry season.

During the inevitable and sometimes seemingly endless New Mexico dry season, plants that cannot tolerate dehydration will die. Plants of different types survive dehydration to different degrees. Plants of moist climates die relatively quickly during an extended drought. The fern species at the City of Rocks can withstand much more severe dehydration through a long drought. They do this by producing special proteins and sugars that help reduce and repair damage to their tissues. They then rapidly rehydrate when rains finally return.



Figure 5. Fern habitat on the west flank of Table Mountain.

Another strategy for survival in the bright sunlight is the formation of farina on the back of the fern frond. Farina is a complex yellowish substance that acts as a natural sunscreen by blocking ultraviolet light. The undersurface of fronds of the fern species Star Cloak Fern (*Notholaena standleyi*) (Figure 3) is coated in farina and is exposed to the sunlight when the dried fronds curl up (Figure 4).



Figure 6. Graceful Lip Fern (*Myriopteris yavapensis*) at City of Rocks.

During sexual reproduction, ferns rely upon rainwater so that sperm can swim to eggs that are protected in special organs on plants that may be inches away. There just aren't enough days of rain at the City of Rocks to support reliable sexual reproduction for most ferns. So many dry-adapted ferns reproduce without going through a sexual cycle—they skip the part about making sperm and eggs altogether and just grow new fern plants directly from the specially-produced spores. In this way, a single plant can produce a whole colony. Since only one plant is required, the species that reproduce this way can disperse to a

greater distance and produce whole new populations further away from the parent population than those species that require two plants for sexual reproduction.



Figure 7. Spiny Cliff Brake (*Pellaea truncata*) at City of Rocks.

So far, six species of ferns have been documented at the City of Rocks. If you want to see these ferns at the City of Rocks, you can see Fairy Swords (*Myriopteris lindheimeri*) if you search carefully in crevices among the shaded boulders of the main campground areas. However, if you want to see the less common species, you will need to make your way carefully a few yards off the trail up to the bottom of the conspicuous canyon on the west flank of Table Mountain (Figure 5). Here, in addition to Fairy Swords (*Myriopteris lindheimeri*), you can find Star Cloak Fern (*Notholaena standleyi*), Graceful Lip Fern (*Myriopteris yavapensis*) (Figure 6), and Spiny Cliff Brake (*Pellaea truncata*) (Figure 7) growing shaded under rocks and in crevices in the tuff. Be sure to also bring binoculars, as water collects in

depressions in the tuff and attracts quite a number of birds including black throated sparrows, rock wrens, and the sage thrasher.

Please enjoy searching for the wonderful little rock-dwelling ferns at the City of Rocks. Take lots of pictures, but leave them undisturbed so that future generations of nature lovers can enjoy their beauty too!

For further reading: [A Natural History of Ferns](#), Robbin C. Moran, Timber Press Inc., Portland, OR, reprinted 2005, 301 pages.

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Thank you for your support and interest. Together we can create an awareness of the wonder, fragility, and importance of City of Rocks State Park.

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Upon receipt of our completed membership application, you will receive a welcome letter, receipt, and membership card. For further information or questions, please call 1-228-363-1403.

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Date Received: _____ Ck#: _____ Cash: _____ Membership Card: _____