Montgomery Botanical NEWS

Advancing research, conservation, and education through scientific plant collections.

Fall 2006 Volume 14, Number 2

Cultivating Discoveries: Plant Collections and Research

Montgomery Botanical Center (MBC) is dedicated to cultivating scientific plant collections for research, conservation, and education. In this mission, MBC fills a role of increasing importance. As botanic gardens expand their roles, MBC is taking a serious look at the profile of plant collections.

THE GARDEN IN HISTORY

Gardens have been integral since our beginnings—the cultivation of plants defines civilization. One of our first cities, Babylon, was long revered for its splendid gardens. Although beautiful, ancient gardens were also functional. Egyptian technology used plants of distant provenance which required sophisticated horticulture and basic research. Carefully tended medieval monastic gardens were live apothecaries. By the Renaissance, the garden was well established for millennia.

Today, these early roles (science and ornamentation) expand and multiply. The modern garden claims many titles: community center, educational leader, research lab, and event venue. But at its heart, plants make the garden—living collections are the vital capital that sustains all other functions to which a garden aspires.

Research, conservation, and aesthetics intersect at Montgomery Botanical. This dramatic mass planting is also a scientific collection of *Cycas panzhihuaensis*, a rare and threatened cycad species from China.

RESEARCH AND THE GARDEN

Universities are amazing engines of research productivity via three factors: research infrastructure, economies of scale, and exclusive access to the best-trained and lowest-cost talent pool—students. Universities are the centers of intellectual capital in our society.

Emulating a university is not the best use of MBC's resources, as our role differs. Whereas universities have immense intellectual capital, gardens are centers of *botanical* capital. As universities increase research capacity, the adaptive response for MBC is to upgrade its plant collections, increasing quality and quantity of plants, documentation, and data.

COMPLEMENTARITY

Complementarity is how Montgomery Botanical accomplishes botany. The off-site researcher is our crucial partner, providing cutting-edge research ability and infrastructure while MBC provides expertly curated live plant collections, with copious associated data. Our plant collections are specifically structured to maximize research utility, being exclusively wild-collected and population-based.

Last year, MBC provided material to dozens of universities. Expert scientists often cannot grow palms and cycads in their specific climate, but these research collections thrive at MBC.

Local plant collections complement each other. Other curated plant collections are near MBC including our colleagues at The Kampong, Chapman Field, Fairchild, and the Gifford Arboretum. We often share material to enhance each other's efforts.

Montgomery Botanical's research includes biogeography, taxonomy, phenology, and long-term natural history studies. As those approaches are now rarer in the university, MBC takes an active role in conserving them, complementing lab-based research at the colleges.

As botany moves forward into the genomics era, scientific plant collections are even more crucial. As partners with our off-site colleagues, Montgomery Botanical Center's role is clear—we advance botany through expertly curated live plant material.

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To advance science, education, conservation and horticultural knowledge of tropical plants, emphasizing palms and cycads, Montgomery Botanical Center collects seeds from wild plant populations around the world and grows the resulting plants in population-based, documented, scientific collections, for use by botanists, scientists, and educators, in a 120-acre botanical garden exemplifying excellent design.

Montgomery Botanical Center (originally The Montgomery Foundation) is a tax-exempt, nonprofit, private institution established by Nell Montgomery Jennings in memory of her husband, Colonel Robert H. Montgomery, and his love of palms and cycads.

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Masthead photo of *Veitchia arecina* (formerly *V. montgomeryana*) by Harvey Bernstein, imaging editor.

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From the Executive Director

Complementarity is the word at Montgomery Botanical Center. Colleagueship, collaboration, and cooperation are the keys to success in our botanical endeavors. Briefly defined, complementarity is like a pair of shoes—without both working together, neither functions quite as well.

This newsletter focuses on complementarity, partnerships, and common interests. Dr. Larry Noblick's collecting expedition in our home state of Florida complements our global palm collections with important local conservation material. Michael Calonje's expedition to the Atlantic slope of Costa Rica complements his previous expedition (and Spring 2006 newsletter article) searching for *Zamia* of Costa Rica's Pacific slope. Ericka Witcher highlights the interplay of cycads and mathematics. Logan Barton, our inaugural Montgomery Intern, represents the value of MBC's partnership with the university community.

Larry Schokman and our colleagues at The Kampong hosted an outstanding international conference this past June, which brought numerous participants from across the globe. At that conference, in spite of the global horticultural luminaries present, it was abundantly clear how much botanical talent we have locally in Miami. It was perhaps the best complement (and compliment) for us to host these global and local guests here at Montgomery Botanical for a survey of our collections.

We were also pleased to host visits by Dr. Barry Tomlinson's Tropical Botany courses this summer. With all of Miami's botanical collections participating, Barry's courses exemplify complementarity. Adding another layer of complement, Dr. Paul Cox accompanied this group and obtained research material from our cycad collections.

As we move forward in our botanical mission, it is good to know that our friends and colleagues support and encourage our efforts, just as we cheer them on and help them meet their goals. This is a great community to be a part of.

Pictured: Dr. Griffith with one of his favorite collections at Montgomery Botanical Center, Pseudophoenix vinifera.

Developing

Our Collections

Florida Has Palms, Too!

Montgomery Botanical Center (MBC) has wild-collected population samples of palms and cycads from all over the world, but very few from Florida other than the native populations growing naturally on site. We had been ignoring our own backyard! So, in November 2005, Harvey Bernstein, MBC's imaging specialist, and I embarked on a Florida palm-collecting trip.

Twelve of the 14 native palm species of the continental U.S. occur in Florida. Six are found only in the Florida Keys or in the Everglades, one is extinct, leaving five for the rest of the state. The St. Joseph Peninsula State Park in Florida's panhandle is truly spectacular. This narrow, over seven-mile long spit of land with pure sugar white sand, miles of pristine beach and dune vegetation distinguishes it as one of Florida's most scenic beaches. It is also the most-western historic distribution for the cabbage palm, *Sabal palmetto*. The *S. palmetto* populations west of St. Joseph are believed to have been planted. The unfriendly saw palmetto, *Serenoa repens*, grows in abundance at St. Joseph, as it does in much of Florida, and is an intriguing species. From one corner of the state to the other, it varies in color from dark green, yellow-green, or blue to silver-green and it varies from nearly stemless populations to those with trunks up to several meters in height. Imagine the difficulties the early pioneers had traversing the state when saw palmetto blanketed Florida in seemingly endless and unbroken stands.

Highlands Hammock State Park, Dr. Noblick climbing to examine *Sabal palmetto* fruit

Lake Wales Ridge, *Sabal etonia* in foreground

Just north of St. Joseph Peninsula State Park are some of the state's most beautiful forests in Florida Caverns and Torreya State Parks. Both are excellent places to appreciate the rare, silvery, palmate beauty of the needle palm, *Rhapidophyllum hystrix*. On its trunk, abundant leaf litter-gathering needles exist with nests of "killer" biting ants. Harvey and I "painfully" collected mature seed between these needles while fighting off the ants. We developed a technique that was fairly successful, but finding seed was due to sheer luck rather than skill. The needle palm is known to recover from temperatures as low as -15 degrees Fahrenheit, making it one of the most cold-tolerant palms in the world.

Two to five million years ago, St. Joseph-like ocean sand dune formations graced a 100-mile chain of ancient islands down the center of Florida now forming the Lake Wales Ridge. While most of the rest of Florida had been submerged at numerous times, the Lake Wales Ridge remains unsubmerged and its ecosystems essentially undisturbed since the Miocene. These Lake Wales paleoislands are home to Florida's oldest and rarest plants. Today, more than 300 feet above sea level, those dunes abound with saw palmetto and the scrub palmetto, *Sabal etonia*.

Nestled between the Lake Wales dunes lies a well-developed, moist hammock—Highlands Hammock State Park—with a few dwarf palmettos, rare needle palms, many 80-foot cabbage palms, and 1,000-year-old live oaks. It is absolutely a "must see" ancient forest, a step back in time and the best place in the state to appreciate the beauty and majesty of the "real" Florida.

Dr. Noblick with *Rhapidophyllum hystrix* in Florida Caverns State Park.

While the scrub palmetto may abound in Lake Wales Ridge State Forest, we spotted the tallest trunked scrub palmetto in Silver River State Park near Ocala. It is just one of the many clear water springs that dot the northern half of the state. Another, called Ponce de Leon Springs, named for the famous Spanish explorer, could have been the legendary fountain of youth. Maybe that explains why the most common palm there was... *Sabal MINOR!*

Florida has many natural scenic habitats, interesting geology, and fascinating legends making our state a fun place to go palm-collecting.

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Developing
Our Collections

Investigating the Pleated-leaflet Zamias of Costa Rica

by Michael Calonje

Costa Rica is a relatively small and narrow country. The distance between the Atlantic and Pacific oceans is 115 km at the narrowest point. One can travel from coast to coast in less than seven hours. Despite Costa Rica's small size, it is remarkably diverse. It is split longitudinally by a central mountain range that reaches a height of 3,820 meters in Cerro Chirripó. This rugged mountain range has varied topography conducive to high species diversity. It also creates a formidable barrier affecting how species migrate and evolve. As a result, there is considerable difference in the species composition of the Pacific and Atlantic slopes of Costa Rica. Those differences are also notable in Costa Rica's native cycads.

On a Montgomery Botanical Center-sponsored expedition to the Pacific slope of Costa Rica in November of 2004, we were surprised to find three distinct taxa of *Zamia*. According to herbarium records, those were all considered *Zamia fairchildiana*. In contrast, the Atlantic slope of Costa Rica contains mostly pleated-leaflet zamias of the *Z. skinneri* and Z. *neurophyllidia* species complex.

In 1851, Warscewicz described *Zamia skinneri* based on plants he collected in Panama. All Central American pleated-leaflet zamias were considered to be this species until 1993 when Dennis Stevenson segregated them into three species: *Z. skinneri*, *Z. neurophyllidia*, and *Z. dressleri* (Stevenson 1993). Under Stevenson's species concept, *Z. dressleri* has a subterranean trunk and leaflets 30-50 cm long; *Z. neurophyllidia* has an aerial trunk to 60 cm tall and leaflets less than 20 cm long; and *Z. skinneri* has an aerial stem up to 250 cm tall and leaflets 30-50 cm long. Stevenson originally described *Z. neurophyllidia* as endemic to Panama. But all pleated-leaflet *Zamia* populations ranging from northwestern Panama through Costa Rica's Atlantic slope and into southern Nicaragua have since been considered *Z. neurophyllidia*.

The morphological differences and genetic relationships among these widely scattered populations of pleated-leaflet *Zamia* are poorly understood. The opportunity to help clarify these relationships presented itself in January 2006, when I returned to Costa Rica on a two-week, MBC-sponsored expedition to take a closer look at the pleated-leaflet *Zamia* of Costa Rica's Atlantic slope. Accompanied by my brother, Christopher, and biologist Claudia Gutierrez, we collected data, photographs, living material, and herbarium specimens from widely scattered populations of pleated-leaflet *Zamia* along Costa Rica's Atlantic slope. On this trip we also took detailed measurements of vegetative and reproductive structures of 25 plants within each pleated-leaflet *Zamia* population to contribute to the dataset of similar measurements taken by Dr. Alberto Taylor, cycad researcher at the University of Panama, and former Montgomery Botanical Center biologist, Jody Haynes.

Author and female *Zamia neurophyllidia* with 46 cm-tall trunk, from inland population.

In two weeks we visited eight distinct locations along Costa Rica's Atlantic slope. We began exploring mountainous areas 125 km from the Atlantic Ocean and made our way east all the way to the coastal area bordering Panama. We found pleated-leaflet zamias at every site and were surprised to find some considerable differences between the inland pleated-leaflet *Zamia* populations and those populations near the Atlantic coast bordering Panama. The inland *Zamia* populations achieved a maximum trunk length of 55.5 cm, matching Dennis Stevenson's description of *Z. neurophyllidia* having trunks up to 60 cm tall. However, the leaflets on these plants were not less than 20 cm long as in Stevenson's description, but up to 36 cm long and with an average length of nearly 27 cm.

On the other hand, the pleated-leaflet zamias near the coast were much larger plants than the inland populations. The largest plant we saw near the coast had a trunk length of 270 cm! This was closer to Stevenson's description of *Zamia skinneri*, which he reported could have a trunk up to 250 cm tall. However, the leaflets on these plants were not 30-50 cm long as in Stevenson's description, but a maximum of 30 cm and on average closer to 25 cm long. With none of the pleated-leaflet *Zamia* populations visited during the Costa Rica expedition matching existing species descriptions, our trip ended with more questions than answers: Were the inland plants smaller because they had migrated there recently from the coast, or were they a truly distinct species from their coastal relatives? Do the descriptions for *Zamia neurophyllidia* and *Z. skinneri* need to be expanded to fit populations documented in the Costa Rica expedition, or were the Costa Rica plants different from either of those?

Although our expedition ended with many questions, we were encouraged by the fact that the detailed measurements, photographs, herbarium vouchers, and living material collected during this two-week expedition would eventually help untangle the complex relationships among populations of the Central American *Zamia skinneri* and *Z. neurophyllidia* species complex.

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Stevenson, D.W. 1993. The Zamiaceae in Panama with comments on phytogeography and species relationships. *Brittonia* 45: 1–16.

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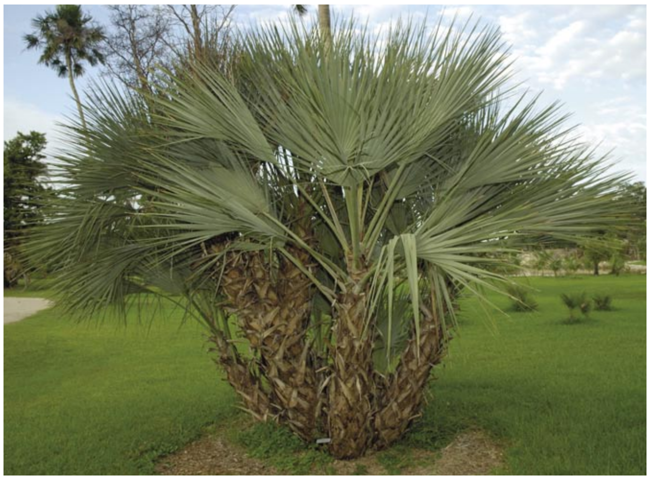
PALM ARCHITECTURE AT MONTGOMERY BOTANICAL: *HYPHAENE*, *NANNORRHOPS*, AND *NYPA*

Palms are not usually considered branching plants, although individuals occasionally develop multiple crowns due to injury or disease. Most species that branch do so at the base of the original stem. A few species exhibit aerial branching, growing multiple crowns from a single trunk. Genera may include species that branch either basally, aerially, or both. *Hyphaene*, *Nannorrhops*, and *Nypa* include palms that display this atypical growth form. MBC's collections include populational plantings of these genera.

Basal-branching *Hyphaene coriacea* at MBC

Hyphaene is a genus of approximately ten species widely distributed across Africa, coastal Arabia, and the west coast of India. Some species of *Hyphaene* develop multiple trunks that are considered basal branches, others branch more conventionally. *Hyphaene thebaica*, the Doum palm, is the branching palm depicted in classic views of Egyptian life along the Nile. *H. dichotoma* is threatened in its native India due to habitat destruction. Where they naturally occur, *Hyphaene* are used for thatch, timber, fuel, and in the production of palm wine.



Nannorrhops ritchiana with basal and aerial branching

At MBC, we grow four species, totaling fifty-one individuals of *Hyphaene*. They are easily cultivated throughout Florida and other parts of the southern United States. *Hyphaene* palms are tough, disease-free plants that are extremely heat, drought, and frost tolerant. They thrive in full sun and appreciate moderate irrigation or access to groundwater. They can become dramatic architectural landscape specimens, whose only potential drawback is their relatively slow growth rate.

Nannorrhops ritchiana, the Mazari palm, belongs to a monotypic genus found in Arabia, Iran, Afghanistan, and Pakistan in semi-desert areas. Typical mature individuals branch both basally and aerially. *Nannhorrhops* exhibits a dichotomous, monocarpic branching pattern. Twin branches fork at the top of an erect trunk. One branch develops a single terminal inflorescence and then dies back. The second eventually develops its own inflorescence. *Nannorrhops* is utilized for thatch, fiber, and fuel in its native range.

Nypa fruticans flourishing at Montgomery Botanical Center

Nannorrhops is found in mountainous habitats where winter snowfalls and subfreezing periods occur. It is considered one of the most cold hardy palms. In cultivation, it can withstand brief exposure to temperatures below 15 degrees Fahrenheit. It will grow in a range of climates provided that its requirements of full sun, excellent drainage, and warm summers are met. *Nannorrhops* does very well at MBC, but does not develop viable seed in south Florida. Montgomery Botanical Center has five individuals of *Nannorrhops*. The grayish or silvery-green leaves, interesting form, moderate size, and trouble free cultivation make it a desirable, yet uncommon landscape subject.

The peculiar monotypic genus *Nypa* displays non-basal trunk branching, but the very short trunks are recumbent and hidden beneath the soil. MBC is one of the few gardens that has the required warm, brackish, estuarine environment for *N. fruticans* to flourish. Hand-pollinated *Nypa* at Montgomery Botanical Center provide the only domestic source of seed.

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Montgomery Botanical & The Community

My Summer as a Montgomery Intern

by Logan Barton

As a horticulture student at Texas A&M University, I was privileged to be the first Montgomery Intern. Arriving at Montgomery Botanical Center (MBC), I was overwhelmed by the enormous palm and cycad collection. The amazing vistas and species create a great tropical environment. Once I experienced this atmosphere, I knew MBC would be an incredible place to intern. The MBC team was always welcoming and helpful. During my internship, I rotated weekly across MBC's departments, experiencing all aspects of the operation.

In the first week, I worked with nursery curator, Vickie Murphy. MBC's nursery is similar to the Texas A&M Gardens, yet I learned new techniques, such as cleaning *Zamia* seeds, and the best growing practices for palms and cycads.

During the next two weeks I learned many "tricks" in palm and cycad management. With the palm team (Laurie Danielson, palm curator; Charles Bauduy and Randy Russ, assistant palm curators), I built shade structures over chamaedoreas and licualas to augment the hurricane-thinned canopy. Other work included planting, trimming, and watering. Working with Stella Cuestas (assistant cycad curator), I recorded data from the Cycad Savanna experiment, and trimmed scale-infested leaves to increase air flow and reduce the area needing treatment. Learning to identify and properly manage the many palm and cycad species was challenging and fascinating.

During the next couple of weeks, I trained on power equipment with dicot curator, Christina Dupuy, and grounds supervisor, Scott Massey. I used the power pole saw to raise the canopies of trees over the roads and learned to operate larger equipment such as the front-end loader and backhoe.

Next, I moved on to work with the Collections Development team. I worked on cycad phenology, collecting seeds (with Judy Kay, seedbank coordinator), and entering data (with database specialist, Arantza A. Strader). I also learned BG-Base and BG-Map, which record the history and location of each plant at MBC.

My final three weeks, I worked on a self-directed project with help from the MBC team. I decided to design new planting beds to install more *Dioon* specimens. First, I laid out the beds and removed the existing turf. After selecting plants from MBC's nursery collections, I carefully sited, planted, and mulched the beds with the help of MBC landscapers, Willie Payne and Jesse Pender. Then, I recorded, surveyed, and labeled the plants with the help of field supervisor, Laura Vasquez, and Sandra Rigotti, field specialist. This project combined all the techniques and skills learned over the summer.

The Montgomery Internship was a great success, exposing me to the work of a large botanical garden. I thank the MBC team for their great respect and for teaching the many aspects of MBC in a short timeframe. I also appreciate having had the opportunity to visit local plant collections. The invaluable skills and techniques I learned through my Montgomery Internship will be useful in whichever field I choose.

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Montgomery Botanical Nursery Repairs Complete

Montgomery Botanical Center's nursery complex includes one glass greenhouse, three shade houses, and one-full sun nursery. The nursery complex suffered extensive damage during the 2005 hurricane season.

To prepare MBC's nursery complex for a hurricane, we place smaller plants under the benches; push the remainder of the plants together to minimize wind damage; and water heavily to weigh down the pots. It is safer to let plants blow over rather than tie them upright, but plants must be righted within 24 hours after the storm. We also mark accession numbers on all pots which is in addition to the identifying tags secured in the soil. Plants that cannot be positively identified are no longer considered scientifically valuable at MBC.

Hurricane Katrina damaged MBC's full-sun nursery. The full-sun nursery's ground-cloth area had just been refurbished in early 2005. During Katrina, high winds pulled up one strip of the ground cloth, scattering small *Macrozamia* plants in two-gallon pots.

Hurricane Wilma ripped the tops off the three shade houses. The shade cloth peeled back in large pieces and wrapped around nearby trees. In such situations, the possibility of sunburn on shade-loving plants is a concern. The MBC team quickly made temporary repairs to all three roofs using the damaged shade cloth. We are also using the old shade cloth for temporary shade structures in the field to provide shelter from the extensive loss of tree canopy. Although the shade structures themselves received little damage, their anchors were bent and pulled partially out of the ground. Hurricane Wilma also destroyed what remained of the full-sun nursery.

Repairs to MBC's three shade houses were completed on June 15, 2006. Due to the extensive hurricane damage suffered by many large commercial nurseries in south Florida, getting repair estimates took months. Once underway, the repairs to the structures were completed in two weeks. As nursery curator, I received quite an education in shade house construction and repairs. As of this writing, the Montgomery Botanical team is completing repairs to the full-sun nursery.

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Conservation through Cultivation

Montgomery Botanical Center's conservation collections are ever more crucial. In a recent speech, noted futurist Dr. Paul Saffo charged the assembled botanists and gardeners with this strong statement: "The environmental movement is over." Saffo argued that casting charismatic megafauna (e.g., pandas, whales) as symbols of concern had not succeeded in preserving our natural heritage. Wilderness, he claimed, no longer exists. Therefore, we can no longer depend on natural processes to sustain endangered species. Although Dr. Saffo's words can polarize, there is some truth here. Whereas towns were once scattered through wide wilderness, now the rapidly diminishing and fragmented natural areas are embedded in a matrix of cities, agriculture, silviculture, ranches, and highways—our reach is worldwide and thorough.

Given this reality, MBC's population-based live collections remain the only sustainable method for preserving rare and endangered palms and cycads. For example, our *Corypha taliera* population, collected in 1996, subsequently went extinct in India—MBC's live plants are *crucial* conservation material. Such irreplaceable plants keep Montgomery Botanical absolutely committed to live scientific collections as its primary, undiluted focus. MBC is a recognized leader in conservation through cultivation.

Montgomery Botanical Center depends on your partnership in this mission. Please partner with us through your gift. MBC is a 501(c)(3) not-for-profit institution, and your gift is tax deductible to the extent allowed by law. I am committed to the careful use of your contribution to support effective, pragmatic conservation. Please contact me anytime if you would like more information.

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The Natural Geometry of Palms and Cycads

Have you ever looked at the cone of a cycad or the leaf bases left on the trunk of a palm after trimming and noticed the regular helical patterns spiraling away? Although a mathematical formula may not be the first thing that comes to mind, that is exactly what this represents.

What these plants are demonstrating is called contact parastichy (from the Greek: para=beside, stichous=row). This refers to the positions of the leaves or seeds and their arrangement on the stem, which follows a helical line around the trunk or cone. One set of contact parastichies wind in a clockwise direction and the other in a counter-clockwise direction. (The *Encephalartos* cone pictured has a parastichy of 5, 8.)


Encephalartos hildebrandtii cone at Montgomery Botanical Center exhibiting Fibonacci Series.

What is so fascinating about these patterns is that the numbers involved are all part of the Fibonacci Summation Series, a mathematical occurrence with widespread representation in nature. This series proceeds as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, and so on—each number being the sum of the two previous numbers. In fact, nearly every natural structure with regular spiral patterns—from palms, cycads, and other plants to snail shells and honeycombs—exhibits this mathematical expression of growth. Those natural structures can all be described with numbers from the Fibonacci Series.

Another Fibonacci expression called the Golden Angle is also represented. The Golden Angle (137.5 degrees) is derived from two consecutive series of numbers and is often found in both nature and architecture. In plants, this pattern begins within the apical dome. Each leaf starts as a primordium. As each primordium is initiated, the previous one is pushed farther out from the apex at nearly 137.5 degrees. The angle of divergence for the primordium is optimized when the spiraling sequence follows consecutive numbers from the Fibonacci Series. This means the plant can pack in the optimum number of primordia, allowing each equal space, without crowding.

To continue the intrigue, if a plant begins to extend upward and outward (e.g., during stem elongation from a basal rosette), it can add more leaves to each turn of the stem, thereby packing in more parastichies before they intersect. Yet, even though the plant is altering its phyllotaxis (pattern of leaf arrangement), the number set remains in the series.

The more we observe nature, the more we find expressions of the Fibonacci Summation Series. Now that you've wrapped your mind around this concept, get out and enjoy the intersection of math and botany—witness the geometry of nature.

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FROM THE MONTGOMERY ARCHIVE

This photo, taken at the Montgomery Estate in March, 1953, shows a portion of the original Old Cutler Road. Along the road, among other plants, are native stands of *Pinus elliottii* var. *densa, Serenoa repens, Metopium toxiferum,* and *Coccothrinax argentata.*

This road is preserved on Montgomery Botanical Center property today, although many of the pines succumbed following 1992's Hurricane Andrew.