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Flora of the Marquesas Islands, a multiphase project

By Warren Wagner and David Lorence

Among the most isolated archipelagos in the Pacific, the Marquesas Islands, consisting of 12 main islands, are situated in the Polynesian-Micronesian biodiversity hotspot. Some 2,400 miles southeast of the larger Hawaiian Islands (6,423 sq. mi.), the Marquesas Islands are only about 400 sq .mi., around 20% smaller than the island of Kaua`i. Nuku Hiva, the largest island, is just 50 sq. mi. These relatively young islands (0.7 – 5.5 MYA) have some breathtaking and rugged spires and narrow ridges, but none are higher than 4,000 feet. The Marquesan flora displays a remarkably high degree of endemism despite the islands' small sizes. Nevertheless, human colonization and the introduction of non-native invasive animals and plants over the years have severely impacted the low- to mid-elevation vegetation of the Marquesas. Scattered like green jewels across a remote swath of the South Pacific and seemingly far from the trappings of modern society, the Marquesas have long been a source of fascination for outsiders.

As a result, these islands have attracted a variety of individuals looking to connect with nature or a Polynesian culture free from Western influence. Notably, French painter Paul Gauguin and Belgian singer Jacques Brel both spent the last years of their lives in the Marquesas and were both buried in the cemetery at Atuona, Hiva Oa. The islands have also attracted famous writers and explorers such as Robert Louis Stevenson, Herman Melville, Jack London, and Norwegian ethnographer Thor Heyerdahl who wrote a book called *Fatu Hiva* during his year-long sojourn on the island where he and his young bride attempted (unsuccessfully) to live off the land. Today the Marquesas are reliably connected to the outside world by satellite dishes and mobile phones. There are airports on four of the main islands, although boat travel is required to reach the others. Nevertheless, many Marquesans still maintain

Continued on page 2

Scattered like green jewels across a remote swath of the South Pacific and seemingly far from the trappings of modern society, the Marquesas have long been a source of fascination for outsiders.

Marquesas

Continued from page 1

strong connections to the sea and land, subsisting by fishing, hunting, and growing much of their food in agroforests and plantations, as well as selling copra and, more recently, noni *(Morinda citrifolia* L.*)* which has become popular as a nutraceutical.

The two of us became acquainted while doctoral students at Washington University in St. Louis, Missouri. In 1987–1988 both of us assumed new research positions: Lorence at the National (then Pacific) Tropical Botanical Garden (NTBG) and Wagner at the Smithsonian Institution (formerly at the Bernice P. Bishop Museum). Since the Smithsonian Department of Botany and NTBG had a significant history of working on Pacific islands, it seemed like a great opportunity to collaborate and develop interactions between the two institutions. One logical project was a flora of the Marquesas Islands because of the years of previous work by Smithsonian researchers F. Raymond Fosberg and Marie-Hélène Sachet in the Marquesas and other Pacific islands, and the focus on Pacific botany by NTBG. The Marquesas flora project was initiated informally on Kaua`i in 1988 over drinks during a meeting with Peter H. Raven, who received the Robert Allerton Award that year. So, with a toast and handshakes the NTBG-SI Marquesas Flora project was born. It was conducted under an agreement with French Polynesia to be a collaborative project between the National Tropical Botanical Garden, the Smithsonian Institution, and the Délégation à la Recherche de la Polynésie Française intended to provide a foundational knowledge of the flora as a vital component towards preserving the biodiversity of the Marquesas Islands.

Warren Wagner (left) and other members of the field team (Steve Perlman and Jacques Florence) standing next to the only vehicle they found to rent on Nuku Hiva, during the first collecting trip to the Marquesas Islands in 1988. (photo by D. Lorence)

Cliff vegetation with *Oxalis simplifolia* and *Nephrolepis sp*., with Jean-Yves Meyer climbing to reach plants, Hanahouua, Ua Huka, 2005. (photo by K. Wood)

The first expedition got underway in July 1988, just two weeks after Wagner began his position at the Smithsonian. Some of the team (Wagner and Lorence) flew via Tahiti to the Marquesas while the others departed from Honolulu with Edward H. Carus Jr., owner and captain of the 40-foot sailing vessel *Aeolus* which was used for interisland transportation. Steve Perlman from NTBG, the rough terrain collector, and Jacques Florence, then stationed on Tahiti, completed the collecting team. The project was principally supported by a generous, private donation from NTBG Trustee Cyrus B. Sweet, III and NTBG Fellow Barbara K. Sweet. With these funds and some institutional support from both NTBG and SI, we conducted 8 more expeditions from 1995 to 2005 with various teams comprised of US botanists (including a graduate student, Liloa Dunn, and post doc, Jon Price) and French Polynesian collaborators. Ken Wood of NTBG was involved in all but the first trip. The last trip, supported by Smithsonian Institution's Global Genome Initiative was

made by Eric Schuettpelz, Jean-François Butaud, and Ken Wood in 2017 towards collecting specimens and high-quality DNA of primarily ferns. During the course of the project, additional collections were also made by others, especially Jacques Florence (Flore de la Polynésie Française; 1997, 2004), who made 7 trips (3 with this project), and Jean-François Butaud, who made numerous individual trips as well as the most recent and final one.

The Flora of the Marquesas Islands is a complete account of all the vascular plants found in the Marquesas Islands. This is one of the first flora projects fully developed and presented in a web format <https://naturalhistory2.si.edu/botany/marquesas-flora/> via a site launched in 2002. Over the course of the project 35 additional publications by Lorence, Wagner, Fosberg, Sachet, and Florence along with other collaborators were completed, and include 86 species new to science increasing the known native flora by 25%. They include complete revisions of genera with more than a few species in the Marquesas (*Bidens, Coprosma, Cyrtandra, Ixora, Lepinia, Oparanthus, Psychotria,* and *Trimenia*). About one half of these were published in two special issues in *Allertonia* (1997) and *PhytoKeys* (2011). An additional dozen were published on molecular phylogenetics and biogeography in collaboration with students or post docs.

It took a number of dedicated people working with us to populate the database and develop the public website. In addition to a number of interns and students, the

Continued on page 4

The two project rough terrain collectors from NTBG, Steve Perlman (green jacket) and Ken Wood (red jacket), on ridge of the youngest island, Fatu Hiva, in 2003, plotting a course to make assent of the rugged ridge terrain with few trails. (photo by Jean-Yves Meyer)

Warren Wagner and David Lorence aboard the sailing vessel *Aeolus* contracted for interisland transport, owned and captained by Eward H. Carus Jr., during their first collecting trip to the Marquesas Islands in 1988. (photo by E. Carus)

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Web site:
https://naturalhistory.si.edu/research/botany

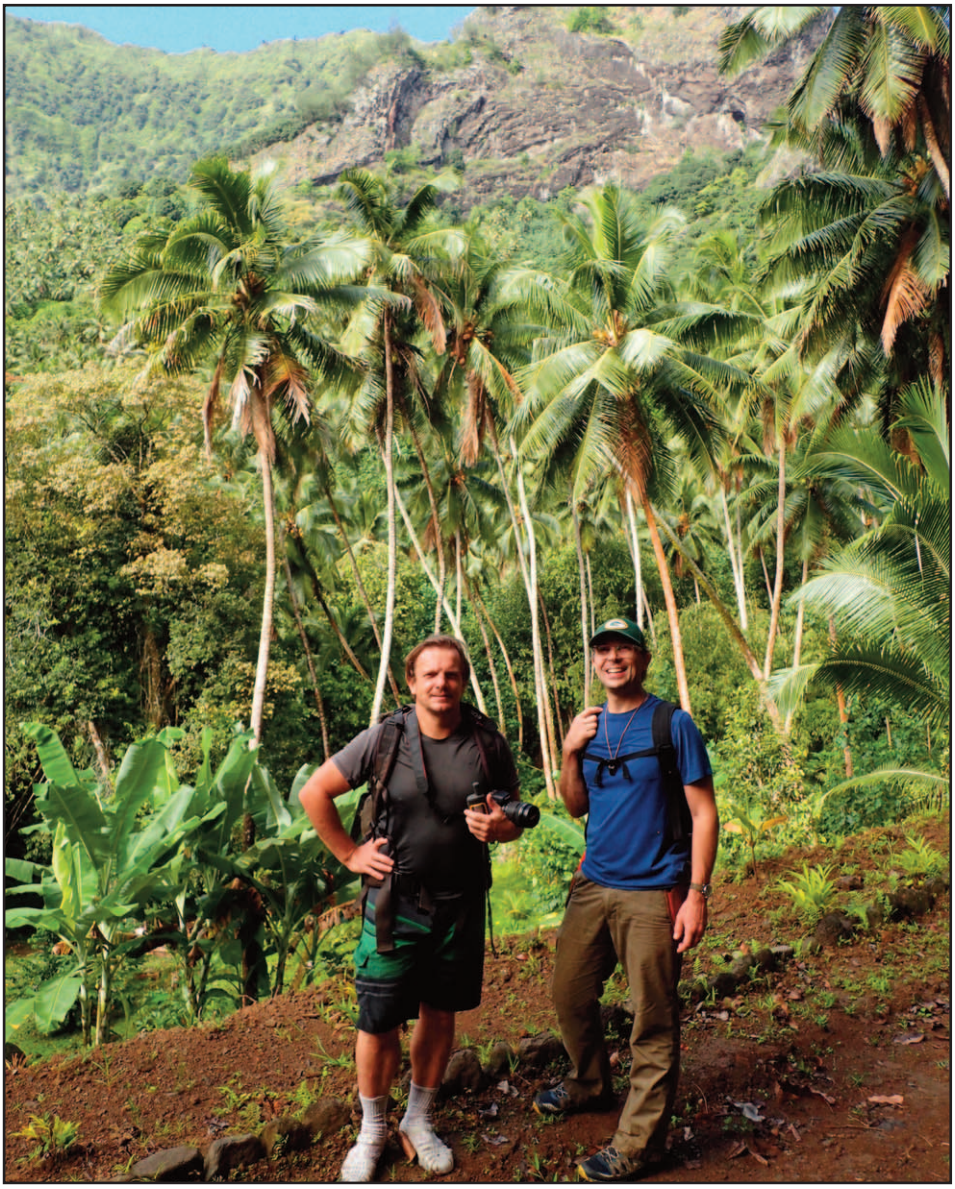
Cover image:* Plakothira perlmanii *(Loasaceae), one of three species of one of two genera endemic to the Marquesas Islands. (photo by Jean-Yves Meyer)

Marquesas

Continued from page 3

following staff and contractors were key in various parts of the project: Mike Sisson (processed the US backlog of Sachet; database BISH collections), Tim Flynn (processed new collections, data entry, distribution of duplicates, parsed descriptions, editing), Royce L. Oliver (d. 1997, worked with Sachet and Fosberg; then WLW 1988-1992 on collections and nomenclature), Liloa Dunn (data entry, vernacular names), Robynn Shannon (database entry; specimen processing), Denise Mix (web design and database entry), Ellen Farr (web design and database structure), Sylvia Orli (Web design), Ken Wood (photography, ferns and content edits, endangered species evaluations), and Nancy Khan (processed new collections, data entry and database and content management, distribution of duplicates, parsed descriptions, and served as project technical editor).

Once all of the data from collections and numerous publications by us and others on Pacific plant lineages and collecting efforts were incorporated into the website database, the data were



Right: The final collecting trip to the Marquesas Islands in 2017 with Eric Schuettpelz (right) and Jean-François Butaud, a major French Polynesian contributor. (photo by K. Wood)

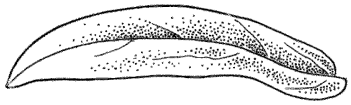
Left: Warren Wagner with Nancy Khan (standing) and Alice Tangerini (seated), without whom the databases, web site, illustrations, and especially the two-volume set would not be possible. (photo by Smithsonian Institution)

downloaded by Nancy Khan in 2018 and formatted into documents to which Lorence and Wagner then added keys, notes, and revisions based on new literature since the original drafts. The books were conceived as a hardcopy version of the web presentation and enhanced by previously published or new illustrations by Alice Tangerini and other illustrators, as well as color plates composed by Tangerini of photographic images taken during fieldwork.

Our research has found that the native flora consists of 100 ferns and lycophytes and 231 angiosperms (flowering plants), with 47 percent of the species endemic to the Marquesas. Of the total 835 vascular plant species recorded for the Marquesas Islands, approximately 495 are aliens introduced by humans, including 257 cultivated, 33 Polynesian introductions, and 214 other naturalized species, compared to the native flora of 331 species. Floristic affinities are with the Society Islands, other Polynesian islands, the Paleotropics, and although a relatively small proportion, a surprising number of original colonists from the Hawaiian Islands and even the Neotropics.

Spanning over three decades, this project has come to fruition with the publication of Volume 1 in late 2019 and volume 2 in September 2020. The two volume set, totaling 1134 pages, includes introductory chapters covering the project's history, Marquesan geology and climate, a history of plant collecting in the islands, floristic qualities and plant communities, threats to the flora, conservation status of species including IUCN Red List recommendations, critical conservation considerations, and many other aspects, as well as taxonomic treatments of the native and naturalized ferns, lycophytes, monocots, and dicots. The volumes are richly illustrated with 391 full page figures including 273 plates of color images, 84 line drawings by Smithsonian illustrator Alice Tangerini, who also served as illustration coordinator, and 34 illustrations by other illustrators, notably Anna Asquith, Cathy Pasquale, and Yevonn Wilson-Ramsey.

The volumes are available at Amazon (search: Marquesas Flora) or contact the authors.



New funding opportunity for botanic gardens

By Morgan R. Gostel[1], Jean Linsky[1], and Abby Meyer[2]

Together with support from the United States Botanic Garden and Botanic Gardens Conservation International, the Global Genome Initiative for Gardens (GGI-Gardens) has announced a new funding opportunity for botanic gardens that supports collection and preservation of genomic tissues new to the Global Genome Biodiversity Network (GGBN) from botanic gardens. This program will support up to 15 awards of up to $4,500 each.

GGI-Gardens was founded in 2015 with the goal of fulfilling the GGI mission – to *preserve and understand the genomic diversity of life on Earth* – for the plant tree of life. Since its beginning in 2015, GGI-Gardens has collected over 400 and 4,500 families and genera of vascular plants, respectively, from 16 active collecting sites and 26 international partners. We hope to collect at least one sample from each family and 50% of genera of plants on Earth. These samples will help facilitate international biodiversity research priorities, such as large-scale genome sequencing projects.

If you are interested in applying, please visit https://www.bgci.org/our-work/services-for-botanic-gardens/global-botanic-garden-fund/bgci-ggi-gardens-partnership-award/

The application deadline is 15 November 2020.

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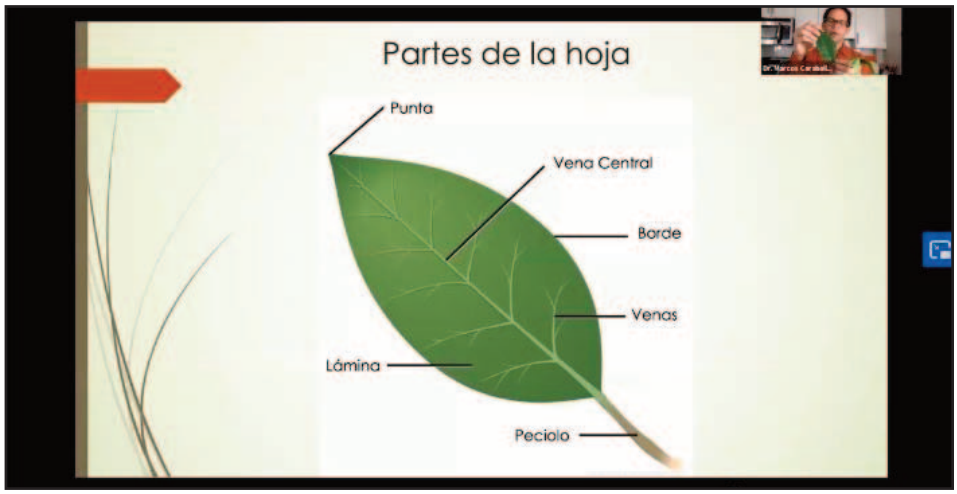
[2]Botanic Gardens Conservation International-US, San Marino, CA, USA

GGI-Gardens collecting team in front of the Bartholdi Fountain at the United States Botanic Garden. Left to right: GGI-Gardens intern, Kristen Van Neste; GGI-Gardens Founder and Senior Research Botanist and Curator, Vicki Funk; GGI-Gardens Director, Morgan Gostel; and GGI-Gardens intern, Sarah Gabler. (photo by Kyle Wallick)

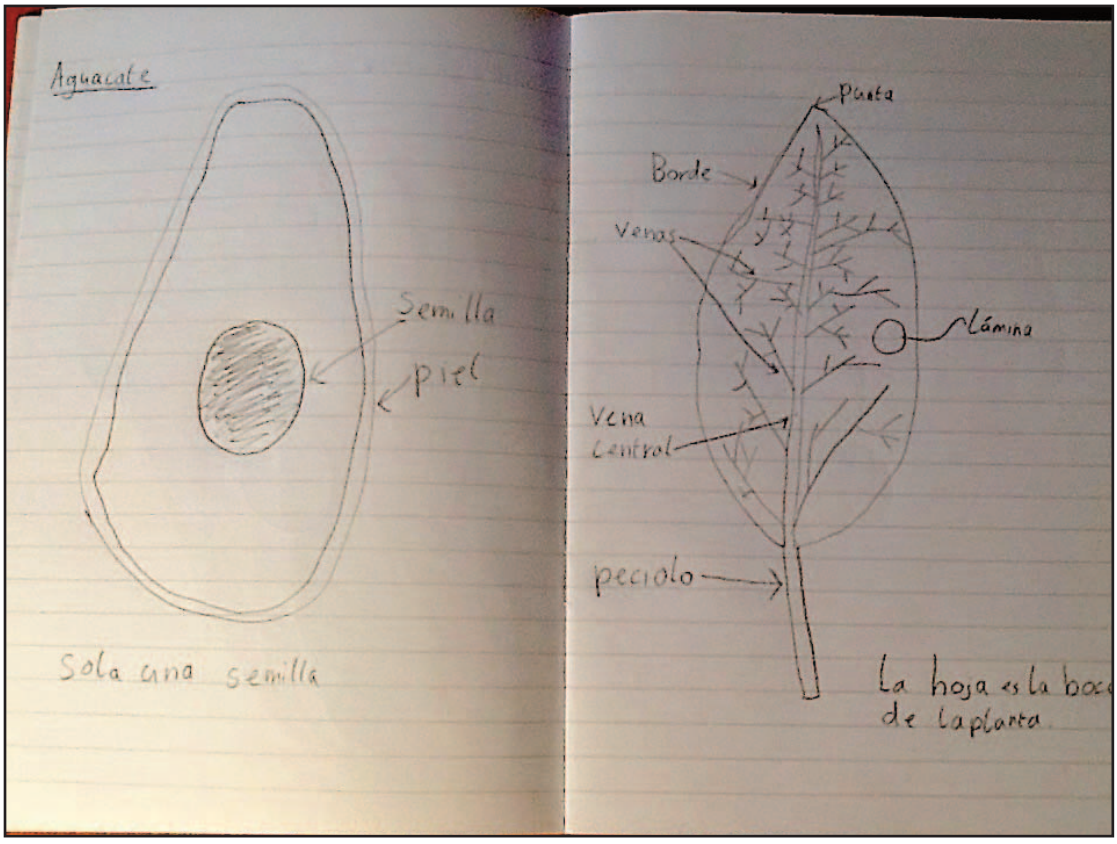
Summer explorations: Descubre la historia natural

In early August, scientists from the Departments of Botany, Vertebrate Zoology, and Mineral Sciences joined staff from across the museum to participate in ¡Descubre la historia natural!, the last of a three-week-long online Summer Explorations series hosted by the National Museum of Natural History's Office of Education, Outreach, and Visitor Experience. The Spanish-language program attracted audiences from across North and South America, as well as participants from Europe. The five-day program was led by educators Odalys Lugo-Morales and Juan Pablo Hurtado Padilla. It featured Efrain Tejada (Museum Educator) and Chris Mooney (Insect Zoo) giving an introduction to the museum, Vanessa Gonzalez (Genomics Scientist) on genomics, Hurtado Padilla (Microscopy Educator) on electron microscopy, Adela Roa-Varon (Ichthyologist) discussing what makes a fish a fish, **Marcos Caraballo Ortiz** (Botanist) exploring the structure of fruits and seeds, and Gabriela Farfan (Mineralogist) on the art and science of creating gems.



Marcos Caraballo Ortiz teaches students how to draw different types of leaves during the five-day Spanish-language virtual program, ¡Descubre la historia natural!

The program was recommended for students in grades 3-7, but was open to all ages. Science skills were taught through live webinars, recorded videos, and hands-on activities and projects. During the week, participants were encouraged to create their own personal natural history field books and they were invited to share their entries at the end of the program. All lessons have been archived and are available on the program's website at <https://naturalhistory.si.edu/education/natural-history-summer-explorations/descubre-la-historia-natural> and submissions from the participants can be seen at <https://spark.adobe.com/page/WeEqVWMAgvz1F/>.



Pages from a student's personal natural history field book created during the five-day Spanish-language virtual program, ¡Descubre la historia natural!

Global Strategy for Plant Conservation succeeds in aligning actions to protect plant diversity around the world

-Adapted from the Secretariat of the Convention on Biological Diversity

A new report on the Global Strategy for Plant Conservation (GSPC) suggests that while the 16 targets of the decades long plan to protect global plant are unlikely to be met, countries have made considerable progress towards achieving many of them. Such progress is the result of actions under the strategy, with several new initiatives developed specifically to address GSPC targets. In the absence of the GSPC, these actions would not likely have taken place.

These actions include the establishment of a World Flora Online and a Global Tree Assessment. The World Flora Online is led by a Consortium of over 40 key institutions (which includes the National Museum of Natural History-NMNH) to create an open-access web-based compendium of the world's 350,000 species of vascular plants and mosses (GSPC Target 1 - online flora of all known plants). The World Flora Online provides a comprehensive baseline of knowledge on the world's plants. The Global Tree Assessment, which aims to have completed Red List assessments for all the world's tree species by 2020 (GSPC Target 2 - assessment of the conservation status of all known plant species), is of fundamental importance in helping prioritize national actions. The Assessment aims to ensure that no tree species becomes extinct, despite showing that currently one in five tree species globally are known to be threatened with extinction. The Global Tree Assessment is managed and coordinated by Botanic Gardens Conservation International (BGCI) working with the IUCN Species Survival Commission's Global Tree Specialist Group (GTSG). The GTSG has over 80 tree experts from countries all around the world, including members of Smithsonian's Department of Botany, who are contributing information and carrying out species assessments.

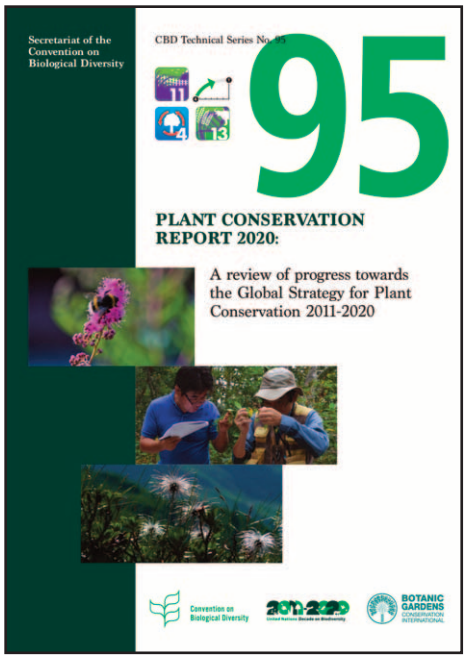
"Plant diversity is crucial in the functioning of all ecosystems," said Elizabeth Maruma Mrema, Executive Secretary, Convention on Biological Diversity. "The decline of plant biodiversity is an illustration of a larger problem in our relationship with the natural world. As we work to achieve the 2050 Vision of the Strategic Plan for Biodiversity, botanic gardens and the Global Strategy for Plant Conservation play a crucial role in protecting biodiversity and fostering stewardship."

"Like the assessment in the fifth edition of the Global Biodiversity Outlook, the Global Strategy for Plant Conservation shows that while there has been important progress, we need greater efforts to achieve the GSPC targets. To reach these goals in the post-2020 Global Biodiversity Framework, we will need the engagement of all actors."

Peter Wyse Jackson and Maïté Delmas, Co-Chairs of the Global Partnership for Plant Conservation (GPPC), which has brought together over 60 of the world's most important plant conservation organizations, including NMNH, added: "Plant diversity is of fundamental importance to sustaining all life on Earth, providing the basis for human livelihoods and wellbeing. The Plant Conservation Report <www.cbd.int/gbo5/plant-conservation-report-2020> highlights the initiatives, actions and innovations carried out over the last 10 years to ensure the conservation of plants through the implementation of the Global Strategy for Plant Conservation."

"Although the ambitious targets have not all been achieved, this report documents the commitment and considerable achievements of communities working together to address the challenges of safeguarding the world's plant species and their habitats. It also highlights the necessity of continuing this work within the post-2020 Global Biodiversity Framework."

Importantly, many of the world's most biodiverse countries (including China, Mexico and South Africa) have developed national plant conservation strategies in response to the GSPC to promote plant conservation and bring together stakeholders. Collectively, these countries are home to over 50 per cent of the world's plant diversity and, in the case of Mexico and China, targets have been set that extend beyond 2020.



The aim of the Global Strategy for Plant Conservation is to act as a catalyst for working together at all levels - local, national, regional and global - to understand, conserve and use sustainably the world's immense wealth of plant diversity whilst promoting awareness and building the necessary capacities for its implementation.

The Strategy's 16 targets, organized around five objectives, were first agreed in 2002 and were the first targets for biodiversity conservation to be adopted at the global level by the international community. Through the strategy, the plant conservation community has been able to engage with and contribute to the development of the post-2020 global biodiversity framework, to be agreed next year in China.

The plant strategy has also provided an important entry point for many non-governmental organisations support for the implementation of the Convention on Biological Diversity <http://www.cbd.int>. It has stimulated considerable growth in networks and partnerships at national and global levels and has resulted in the development of a broadly-based, multi-

Continued on page 8

Plant Conservation

Continued from page 7

stakeholder, united community, committed to ensuring the conservation and sustainable use of plant diversity into the future.

Progress towards the 16 targets has been variable – among both the targets and Parties. However, most countries report some progress towards most of the targets. Apart from targets 1 and 2, Target 14 (public awareness of plant diversity) is the most likely target to be achieved at the national level, with targets 7 (*in situ* conservation), 10 (invasive species) and 12 (sustainable use), being those where least progress has been made. Other examples of progress on specific targets include national initiatives to identify and protect important areas of plant diversity in many countries and to conserve the threatened plant species within them.

Most progress was made with targets that were measurable (so-called SMART targets), and supported by a focused and committed community. A lesson learned is that it is critical for countries to have available and accessible data at national and global levels, as well as greater alignment, linkages and reporting between the GSPC and other CBD frameworks. Capacity building initiatives have made extensive contributions to GSPC implementation and many initiatives have been directly supported by Parties.

Countries have shown strong support for the continued inclusion and visibility of plants in the post-2020 global biodiversity framework. This can be best achieved in the context of a continued Global Strategy for Plant Conservation, one that is updated and harmonized within the broader post-2020 framework, in addition to the inclusion of plant-specific milestones, components and supporting indicators within the post-2020 framework.

These could include species recovery plans as a prerequisite for successful conservation; plant conservation and sustainable use clearly supporting poverty alleviation and economic development, including in urban areas; compliance with the Nagoya Protocol, but facilitating access to plants for conservation, science and sustainability; and, ecological restoration focusing on the use of appropriate native plant species in order to ensure resilience and diversity in restored areas.

Reflections on the Botany 2020 virtual meeting

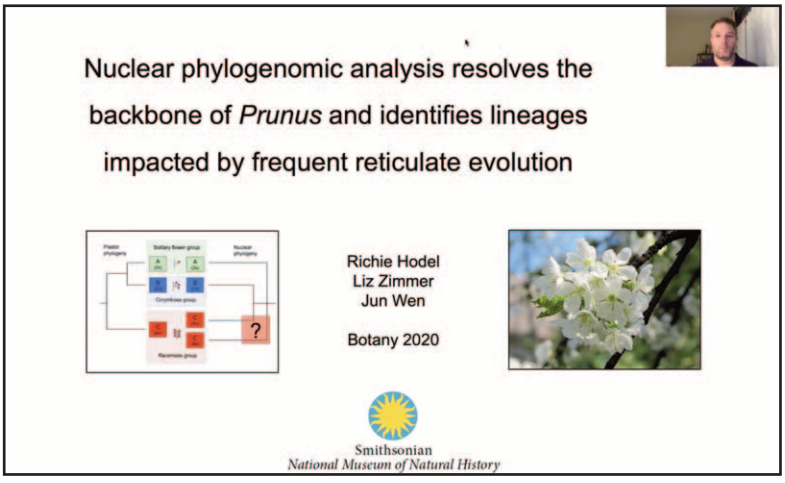
The Botany 2020 meeting was held virtually on July 27-31 this year, as an alternative to the on-site meeting originally planned to be held in Anchorage, Alaska. The virtual meeting was a great success considering the circumstances of the pandemic. The virtual platform and the low registration fees ($100 per person to pay for IT support to manage all the video talks) enabled many international colleagues to participate in the conference, most of whom may not have been able to attend the meeting if it was held on-site. Many international researchers, especially students, were able to attend the meeting and interact with colleagues in a conference setting for the first time.

Botany 2020 was attended by 1,323 botanists, substantially higher than the typical attendance for a Botany meeting. The conference attendees hailed from over 45 countries and all 50 U.S. states; there were 439 contributed papers and 202 posters presented, as well as 14 workshops, 7 special lectures, 5 symposia, and 10 colloquia. Many attendees praised the thorough organization and seamless execution of the meeting, and an article published in Science Magazine on virtual scientific meetings highlighted the Botany meeting as a success story (https://www.sciencemag.org/careers/2020/09/virtual-scientific-conferences-open-doors-researchers-around-world).

Several colleagues in Smithsonian Botany presented their research at Botany 2020. These include virtual talks by **Bort Edwards**, **Richard Hodel**, and **Jun Wen**, a virtual class on botanical drawing by **Alice Tangerini**, and posters by visiting graduate student **Chun Su** and visiting scientist **Lei Duan**. Several curators (**Eric Schuettpelz**, **Warren Wagner**, **Ken Wurdack**, and **Liz Zimmer**) participated in the meetings. The pre-recorded virtual format of the talks enabled the speakers to interact with colleagues and answer questions via chat during the entire talk. The recorded talks are available to attendees for a year after the conference, enabling attendees to catch up on talks they missed due to conflicts in concurrent sessions, or re-watch talks relevant for their own research.

Jun Wen also moderated the Cooley Award session with 10 talks, sponsored by the American Society of Plant Taxonomists (ASPT). In the Cooley Award session, graduate students and early-career researchers and postdocs received lots of encouraging feedback from peers and senior scientists. It was a collegial and supportive session with many excellent talks presented by the young generation of systematists.

At the ASPT Awards Zoom session, visiting graduate student Chun Su was awarded one of the named Graduate Student Research Grants—the Shirley and Alan Graham Grant—in the amount of $1500.00.



Richard Hodel's title slide from his recorded talk on the phylogenetics of *Prunus*, from the Botany 2020 meeting held virtually on July 27-31.

Artwork by Regina Olson Hughes featured in a National Technical Institute for the Deaf exhibition

The Dyer Arts Center, part of the National Technical Institute for the Deaf at Rochester Institute of Technology in New York, has put together an online exhibition focusing on deaf artists and plants. The exhibition, "Palettes of Nature," went live on September 22. Among the artists featured is **Regina Olson Hughes** (1895-1993). Hughes was a scientific illustrator who came to the Smithsonian's Department of Botany after retiring from her position in 1969 as a staff illustrator for the U.S. Department of Agriculture (USDA). She continued to work at the Smithsonian until the age of 95.

At the National Museum of Natural History, Hughes worked as a contract illustrator for scientists at both USDA and the Smithsonian. She painted orchids from the National Orchid Collection for **Robert W. Read** and a large number of Asteraceae for **Robert M. King** and **Harold Robinson** (for example, see *The Genera of the Eupatorieae (Asteraceae)*, https://www.biodiversitylibrary.org/page/57564021).

Four of Hughes' orchids appear in "Palettes of Nature" including *Encyclia* (Spring), *Lockhartia* (Early summer), *Huntleya* (Fall) and *Vanda* (Winter). The exhibition features images by season and subject. Hughes' watercolors were provided courtesy of the Smithsonian Institution. The exhibition can be viewed at https://dyerartscenter.omeka.net/exhibits/show/palettesofnature/intro.

Many illustrations by Hughes are found in the Department of Botany's Botanical Art Collection. Her works are available for viewing in the Botany Online Catalog at https://collections.nmnh.si.edu/search/botany/?ti=7. A selection of 67 works by Hughes are currently included in the catalog, with 33 orchid watercolors and the others in pen and ink. An additional 20 or so orchid watercolors have not yet been scanned.

Botanical Illustrator **Alice Tangerini** fondly remembers Hughes, "She had a sense of humor which served her well in the speaking world of the botanists. She could foretell what a person would say before they said it." Tangerini shared an office with Hughes for over 20 years. "I learned so much from her, in art, science, and dealing with scientists," says Tangerini.

The watercolor, *Huntleya fasciata* (Orchidaceae), by Regina Olson Hughes is currently featured in "Palettes of Nature," an online exhibition hosted by the National Technical Institute for the Deaf.

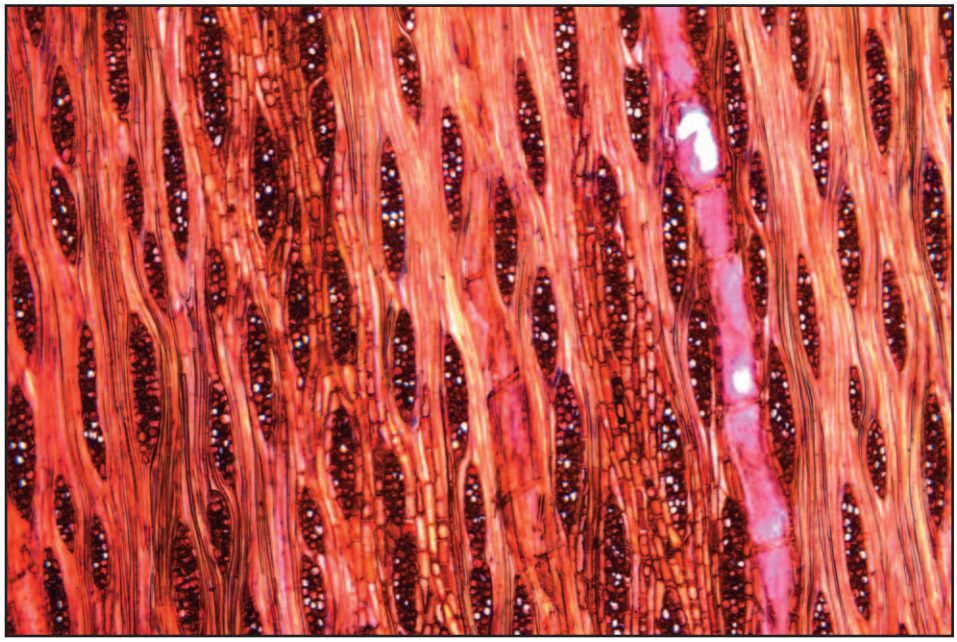
"What wood is that?": Expanding the toolbox for species identification

By Julia Campbell-Such

The National Museum of African Art at the Smithsonian holds many beautiful works of art made from wood, but only rarely do our records indicate what species of wood the artist used. This is not unusual for a museum, but it is a shame since so much can be learned about a piece of art from understanding the materials that were used to make it. Artists choose their materials carefully for their physical characteristics but also, especially in the case of art originating on the African continent, for their symbolic value. Certain tree species can impart meaning, or even metaphysical powers, to an object made from its wood. The identification of which tree species used in African art and belongings can help researchers recreate the history of artworks with uncertain provenance and elucidate the symbolic worlds of those who created them.

Increasingly, species identification is also important in the context of the enforcement of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), an international treaty to prevent species from becoming endangered or extinct because of international trade. Without proper documentation demonstrating that objects are not made with endangered species, museum artworks travelling to exhibitions abroad may be held, confiscated, or even destroyed by customs officials. Knowing which wood was used can help protect artworks when they travel.

As an Andrew W. Mellon Fellow in Object Conservation at the Smithsonian National Museum of African Art, I have been investigating ways to answer the question, "What wood is that?", for artwork in the museum's collection for the past two years. Using the Jane Smith collection of 64 hand samples representing over 50 species of West African woods, I have been comparing traditional wood anatomy to newly developed methods that use the tree's chemistry, as well as its anatomy, to identify it. With the generous support of the Botany Morphology Lab at the National Museum of Natural History, under the supervision of **Kenneth Wurdack** and the kind, generous tutelage of **Stanley Yankowski**, I have been preparing and examining wood slides from this collection. I have then been comparing the results of that anatomical analysis to direct analysis in real time mass spectrometry (DART-MS) of the same samples, conducted at the Smithsonian Museum Conservation Institute under the supervision of G. Asher Newsome.



Tangential section of a sample from the National Museum of African Art Jane Smith Collection of West African Woods, most likely *Entandrophragma utile,* under 16X magnification.

One of the reasons wood species are not often identified for works of art is the size of sample required to do traditional anatomy. The 1 cm cube generally necessary for an accurate identification is a huge chunk for art conservators who usually measure their sample sizes in millimeters or even microns. DART-MS, which requires only a splinter-sized sample, is therefore a promising alternative, or compliment, to anatomy for wood species identification. This technique uses an ambient ionizing source, the DART, to desorb and ionize small molecules from the surface of the wood, which are then transmitted to a mass spectrometer for analysis. Spectra representing the mass-to-charge ratios of ionized molecules in the sample can then be compared to a database of knowns using computer learning algorithms. Specific chemicals can also be identified in the spectra to further confirm species.

The technique of using DART-MS to identify woods was developed at the U.S. Fish and Wildlife forensics lab by Cady Lancaster and Edgard Espinoza, who have been using this system to enforce CITES-based regulations on the trade of endangered tree species. Using vouchered samples from xylaria all over the world, including the Smithsonian's own collection, they have developed a database of DART-MS spectra of known woods called the Forensic Spectra of Trees Database ©, or ForeST. DART, in combination with a time of flight mass spectrometer, has been used to successfully differentiate between red and white oak (*Quercus*) (Cody et al., *J Anal Appl Pyrolysis* 95: 134-137; 2012), various species of rosewood (*Dalbergia*) (Lancaster & Espinoza, *Rapid Commun. Mass Spectrom.* 26: 1147-1156; 2012) and mahogany (*Swietenia*) (Deklerck, *Wood Sci. Technol.* 53: 953-965; 2019), and others. At the Smithsonian Museum Conservation Institute, we have been working with Lancaster and Espinoza to adapt their protocol to our slightly different instrumentation and to identify the species of West African woods most commonly used by African artists. We hope that this collaboration will not only help us to protect and care for the important art in our museums but will also help to further the protection and care of the forests and communities who created those works.

ForestGEO welcomes 72nd plot to the network: Ordway Swisher, Florida, USA

ForestGEO is pleased to introduce its newest research site, the Ordway Swisher Forest Dynamics Plot, a 23.04-ha upland sandhill forest near Melrose, Florida, USA, that undergoes a regimen of prescribed burning every three to four years (including during the establishment of the plot). Field crews began the census in March 2019 and completed it in February 2020, less than one month before the coronavirus pandemic brought fieldwork around the world to a halt. Staff have entered and screened census data, which is now available upon request in the ForestGEO Data Portal. Dan Johnson and Stephanie Bohlman, both of the University of Florida, are the plot's Principal Investigators.

There are 11 tree species ≥1 cm dbh in the Ordway Swisher Forest Dynamics Plot, and the dominant species is *Pinus palustris*, longleaf pine, shown above at different stages of maturity. This species used to be very prevalent throughout the southern U.S. but changes to land use have drastically reduced its presence. (photo by Dan Johnson)

The field crew of the Ordway Swisher Forest Dynamics Plot: Joey Nieves, Jackie Bourdon, Regan Fox, Courtney Deviney, and Allen Percifield. (photo by Dan Johnson)

Fire is needed to maintain the longleaf pine ecosystem, thus Ordway Swisher undergoes a prescribed burn every three to four years. The above photos show the plot pre- and post-burn, respectively. Dan Johnson says, "The post burn photo was 1 month after the fire. This system is amazing because of how everything sprouts right back after fire. Notice in the pre-burn photo all the understory woody plants are taller. The fire kills the aboveground portion, but the root system survives and sends up new shoots within two weeks after the fire." (photo by Dan Johnson)

Selected hydrangea histories

By Julia Beros

After receiving an unusual gift on her front porch, a Botany contractor goes on a journey through the Smithsonian collections to see if she can uncover the intentions of a mysterious neighbor.

It arrived as a bundle. Blue-tinged buds resting on the concrete, halfway into shade, aluminum folded and scrunched at the base molding to the shape of raw-cut branches wrapped in a damp paper towel, a single piece of twine wrapped infinitely around into a limp knot at the waistline. Exactly the way my mother prepared flowers for me to bring for "teacher appreciation week" in elementary school. It was always May, always the first bloom of lilacs. But exponentially wilting as the sun progressed, these blue buds waited anonymously for retrieval.

It was not just our house. Passing the open door I noticed the bundle and went to bring it in. I looked across to our neighbors, our street in quietness, and saw a similar bouquet limp at the steps to their door. Up the street I could see blue lumps at almost every doorstep. Something felt eerily significant about these blue hydrangeas donning every doorway. Something meaningful that could be de-coded. So discreet and common, maybe even a flower used as filler in a garden, hydrangeas never seemed so special. Bringing the flowers to show my mother, she smiled lightly, "they must be from someone on the street. How nice." For her it ended there, "how nice," but "how" is what I suddenly burned to understand. How did these blue buds arrive at all of our homes?

Our house is on a dead-end street, we know every resident of the 16 cape cods lining the road to a singular end, and there is a hyper-awareness of goings-ons. I set out for a walk and would determine which homes had blue hydrangeas growing in their yards. I wouldn't consider homes without a bouquet on the doorstep because, like me, they could have already been picked up. Making a full venture to the park, so as not to arouse suspicion, I walked back down the street and noticed only a single yard with blue hydrangea bushes. This belonged to a couple with small dogs and children who are now adults that live far away. The wife can be seen walking the dogs while wearing a straw hat, her hair buoyantly curly and able to spark the jealousy of women with perms. She has the calm demeanor of a turtleneck worn stubbornly on a warm day, and the relaxed yet determined ambition of someone who knows themselves very well. The husband I've hardly spoken to, and his inconspicuousness is circumscribed by the single fact I know: that he is a writer of history and philosophy. It

Japanese Banko ware serving dish with design of bird and hydrangea, c. 1740-1799, from the Freer Gallery of Art.

The blue buds of *Hydrangea macrophylla f. hortensia* stand out in this specimen collected in 1986 by J.H.R. Plews in Kauai, Hawaii. The specimen is housed in the U.S. National Herbarium.

seemed unusually out-of-character that this neighbor might clip her flowers to share secretly with the rest of the street. But this was the only yard with blue buds.

What did I know about hydrangeas, who did I know that knows things about hydrangeas, don't we have hydrangeas in our yard? Remembering the "snow bush" on the side of our house and my mother clipping these for bouquets, placing the branches in that murky blue vase, but soon replacing them with azaleas and leaving the white hydrangeas to bruise and shatter into the winter, and remembering the cluster of pink hydrangeas in the backyard, a fabled result of the pennies my dad used to bury in the soil near their roots, winking to me as he knelt to the dirt and we shared in this magical secret, and remembering that I always mixed up the name for hyacinth and hydrangea because my dad called them *zumbul* and I didn't learn the name hyacinth until it no longer mattered. With the resources of the Smithsonian and the U.S. National Herbarium at my disposal, I began digging around for some scientific and cultural information about hydrangeas, perhaps leading me to the meaning of these doorstep bouquets. Using the Smithsonian Collection Search

Center, I searched for clues where Smithsonian collections contain hydrangeas <https://collections.si.edu/search/results.htm?q=hydrangea>.

"Hydrangea", or sometimes "Hortensia," and sometimes "Seven Bark," is an easy-care shrub growing readily in zones 3-9. Varying in leaf-shape and growth habit this plant is believed to have been originally cultivated in Asia. They have two flower types on their head, the small ones like specks dotting the air, and the big showy ones with large tepals floating above, creating either pom-pom or lace-cap silhouettes. Their color changes in accordance with aluminum ions which can be influenced by soil pH, and therefore have some correlation with the myth that pennies added to the soil will increase the acidity and in effect change the color expression of the blooms. There are numerous species of hydrangeas and they have been widely cultivated for the exploitation of these traits, namely their chemical vulnerability for color expression, making them an abundantly beloved garden shrub.

A recent cultivar of *Hydrangea quercifolia* introduced by the U.S. National Arboretum, "Ruby Slippers," donning the name of Dorothy's famous shoes and a striking red hue at maturity, and a commemorative stamp from 1995 (when postage had just increased to 32 cents an ounce) depicting blue hydrangea buds are proof of this plant's versatility as a cultural icon. Fabrics and wallpapers, friezes and borders, block prints and mulberry paper with delicately sewn hydrangea buds (and a bizarre wax figurine of a bouquet housed in a glass bell) are preserved by the Cooper Hewitt Museum representing its place in American design history.

Included in the history book *Foxfire Volume 11* is a detailed description of *wild hydrangea*, *Hydrangea arborescens:* According to Appalachian tradition wild hydrangea is called "Seven bark" for the peeling layers of bark revealing different colors. It has slim stems and heart-shaped toothy leaves. Some recorded uses include chewing the bark for stomach and heart troubles, but readers are warned against gathering the bark, as it has "caused painful gastroenteritis and cyanide-like poisoning." The shrub is collected mainly for the root, juicy and tender, and used for kidney and bladder troubles. These traditional medicines, with roots in Native American

Left: A 1995 postage stamp with a blue hydrangea, from the National Postal Museum. Copyright United States Postal Service. All rights reserved. Right: A wallcovering featuring hydrangeas, from the Cooper Hewitt, Smithsonian Design Museum, c. 1905–1915.

cultures that spread through folkloric American traditions, proliferated in pharmacies. Examples of these medicinal histories are preserved as "materia medica" in the National Museum of American History, labeled "crude drugs." Many were developed by the Eclectic School of American Practitioners (founded in the 1830s) as an early form of nontraditional medicine. Diuretic tablets, elixirs, and extracts are other common preparations of this plant in commercial medicine.

In the National Museum of Asian Art there are block prints, paintings, and ceramic kettles and pots with detailed images of hydrangea blooms, very often accompanied by a butterfly. Dating from the Edo, Meiji (that marked by the dramatic shift in international relations), and Taisho periods in Japan, botanical histories as well as cultural and political exchange can be subtly gleaned through these artworks. In the National Museum of African American History and Culture there are photos and portraits of "The Taylor family women" taken at *Playfair* in Martha's Vineyard with descriptive transcriptions noting, "behind the women at proper right is a hydrangea bush." These candid moments of family and life in the 1950s are now archived in a museum, and are supplemented by the appearance of a hydrangea. Outside the museum itself, creamy blooms of hydrangea plantings line the plaza as visitors linger around the entrance posing for their own memories.

In almost every corner of the Smithsonian Institution collections there are hydrangeas. Many are examples of decorative ornamentation, but these too enhance our scientific collections. More than cultural objects, these are unique representations of the plant at a certain time in a certain place, just like an herbarium sheet. As type collections in the herbarium are the didactic representation of a species, the physical iteration of its definition, collectively the various types of representations of a plant depict where it has been, what it serves and symbolizes, and where it may go in our society. How we use or covet a plant,

Continued on page 14

Hydrangeas

Continued from page 13

how we have altered it and likely how it has altered us, how we use this plant to relate to other aspects of our culture and ultimately to each other, are represented in the various preservations of hydrangeas. These hydrangeas mark moments, deeply personal and sentimental as well as historic and momentous, and place our study of biology within the context of social science, and continue to enhance our perspective. In the U.S. National Herbarium there are of course plentiful representations of pressed hydrangea specimens. Among the various species, *H. arguta* a short leafy shrub endemic to Hawaii, or *H. quercifolia* with its giant leaves resembling an oak, one stands out: an *H. macrophylla f. hortensia,* USNH number 3283045, a singular and robust stalk of blue buds, like a mug shot of the unidentified blooms from my doorstep.

Suddenly there were blue buds everywhere. I could see them lining every lawn and peeking from backyards behind house corners, their colors echoed in the faded pink and blue surgical masks smocked with white folds worn around town. I was fixated on a very specific color: the powdery blue of a nail file I've been dulling for 6 months, the fluorescent blue of a plastic star that's supposed to glow at night in my room, even the flashing specks of a neighbor's recycle bin hidden behind a bush, all potentially hydrangeas. How had I overlooked all the clearly existent blue buds before, had they been changing color over the summer? Was everyone in my neighborhood on to me and my hydrangea fixation and suddenly planting bushes to throw me off? Is it possible that I had concocted a narrative in my subconscious that I could follow without logic overlooking the many yards with blue buds, could this be how we so often "miss the obvious" when it was seemingly right in front of us all along? A mood ring for aluminum, able to change so subtly and without notice, the hydrangeas were always there. Always everywhere. With or without the projection of cultural meaning. I pass my neighbor's house every day, sometimes I see her dogs at the window through partly lifted shades, or see a raccoon scramble off the fence at night, and I see the change of her blue hydrangea bush, the buds few and almost purple now, hiding under big green leaves. Nobody on the street ever mentioned the blue buds, nobody really cares, and it really wasn't that compelling of an event. I doubt this neighbor was even the culprit of this charming gesture but I pass her house and think "how nice."

Boericke & Tafel Diuretic Tablets, 1975, with hydrangea as one of its main ingredients, from the National Museum of American History.

A 1950s photograph of three women from the Taylor family posing in a yard in Martha's Vineyard, with a hydrangea bush behind them. Collection of the National Museum of African American History and Culture.

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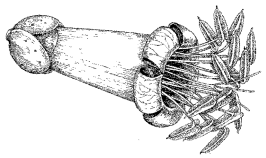

ART BY ALICE TANGERINI

Lebronnecia kokioides Fosberg

Lebronnecia kokioides, a genus and species endemic to the Marquesas Islands, was described in 1966 by Ray Fosberg. When planning a Hawaiian vacation to Kaua`i and O`ahu in 1978, Marie-Hélène Sachet mentioned to Alice Tangerini that she should visit the Pacific Tropical Botanical Garden (now National) and look for a "Brown cotton tree". With Sachet's verbal description of the plant, Tangerini was able to have the helpful staff show her that very tree while she was touring the garden. Tangerini took slides of the tree showing the brown cotton-like bolls on the branches. She illustrated the species from the slides, two specimens (*Schäfer 5323* US and *Sachet 2165* US, both Mohotani), and images of a cultivated living plant. The species is endangered, and current population estimates by Jean-François Butaud (pers. comm. 2007, 2013) report this species from Ua Huka (2 populations, ca. 50 plants), Hiva Oa, and Nuku Hiva (1 population of ca. 50 plants).

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