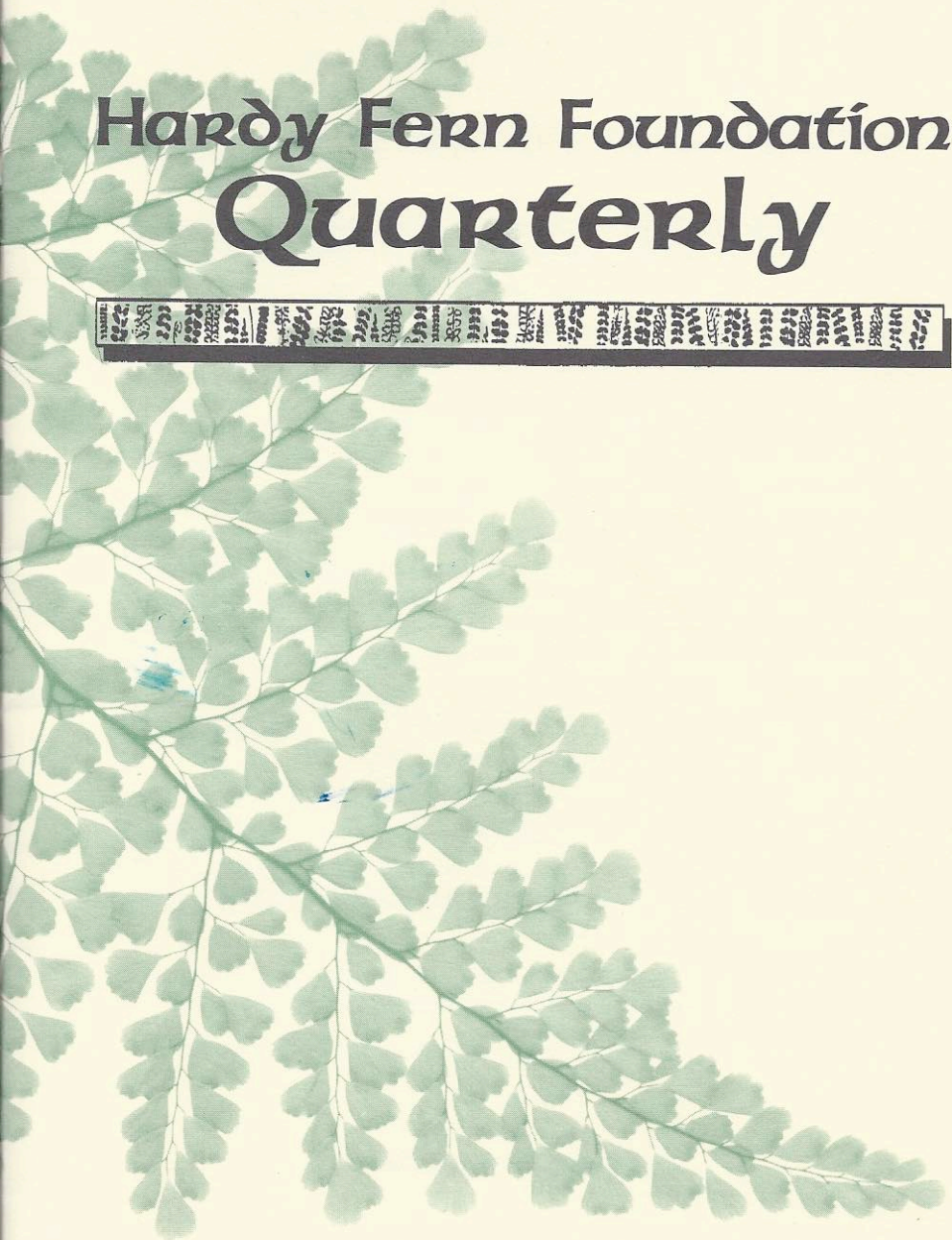


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THE HARDY FERN FOUNDATION

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The Hardy Fern Foundation was founded in 1989 to establish a comprehensive collection of the world's hardy ferns for display, testing, evaluation, public education and introduction to the gardening and horticultural community. Many rare and unusual species, hybrids and varieties are being propagated from spores and tested in selected environments for their different degrees of hardiness and ornamental garden value.

The primary fern display and test garden is located at, and in conjunction with, The Rhododendron Species Botanical Garden at the Weyerhaeuser Corporate Headquarters, in Federal Way, Washington.

Satellite fern gardens are at the Stephen Austin Arboretum, Nacogdoches, Texas, Birmingham Botanical Gardens, Birmingham, Alabama, California State University at Sacramento, Sacramento, California, Coastal Maine Botanical Garden, Boothbay, Maine, Dallas Arboretum, Dallas, Texas, Denver Botanic Gardens, Denver, Colorado, Georgeson Botanical Garden, University of Alaska, Fairbanks, Alaska, Harry P. Leu Garden, Orlando, Florida, Inniswood Metro Gardens, Columbus, Ohio, Lewis Ginter Botanical Garden, Richmond, Virginia, New York Botanical Garden, Bronx, New York, and Strybing Arboretum, San Francisco, California.

The fern display gardens are at Bainbridge Island Library, Bainbridge Island, WA, Lakewold, Tacoma, Washington, Les Jardins de Metis, Quebec, Canada, University of Northern Colorado, Greeley, Colorado, and Whitehall Historic Home and Garden, Louisville, KY.

Hardy Fern Foundation members participate in a spore exchange, receive a quarterly newsletter and have first access to ferns as they are ready for distribution.

Cover Design by Willanna Bradner

THE HARDY FERN FOUNDATION

QUARTERLY

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The Spore Exchange Needs You!

Please send your spores to our Spore Exchange Director:

Katie Burki
501 S. 54th St.
Tacoma, WA 98408

President's Message - Spring 2004

Early spring here in the Pacific Northwest has been just a bit on the cool side, with a fair share of cloudy days, but average rainfall. Last week I observed *Matteuccia struthiopteris*, the ostrich fern, already unfurled showcasing its perfectly vase shaped plumose form in their beautiful, eye catching, soft green color. Our native sword fern, *Polystichum munitum* is just beginning to awaken in this last week of March, its unfurling crosiers, bent and gangly in appearance. The Japanese painted fern, *Athyrium niponicum* 'Pictum' is awakening, their stipes and rachis burgundy-red while its growing frond is just beginning to show its renowned coloring as the blade expands. This is an opportune but fleeting time to observe the emergence of ferns. The various colors that are seen in the emerging and unfurling crosiers will never be so diverse as they are in this early spring period. Add to this the hairs, bristles and scales of various textures and hues that clothe the crosiers of many if not most fern species and this show of emergence becomes quite spectacular.

The HFF annual Fern Festival will be held on June 4 & 5th. Friday and Saturday at the Center for Urban Horticulture at University of Washington in Seattle. The sale will be from 1:00 – 6:00 PM with coffee at 7:00 and a lecture at 7:30 by Glenn Withey and Charles Price. Glen and Charles are renowned garden designers, especially for their internationally acclaimed mixed perennial border at the Bellevue Botanical Garden. But their interests in plants run the gamut and this lecture will be quite entertaining. Plant sales will continue on Saturday from 10:00 – 2:00 with a propagation workshop at 11:00 AM. Each year the sales of the Fern Festival become larger and so the numbers of fern species offered for sale also increase. This fern festival is important for us as a foundation. It is our biggest money earner of the year. Since one of the primary goals of HFF is to increase the diversity of ferns in gardening and horticultural so it is also important that we offer an ever increasing number of ferns for sale at this sale. A sincere thank you to the members of the board in seeing to this task and especially Michelle Bundy, the HFF fern curator, who shoulders the greatest burden in making this Fern Festival the fern happening event of the year in this area.

We have regretfully received the resignation of Becky Reimer from her position of assistant to our fern curator. Becky's dedication, enthusiasm and hard work in working on the myriad of projects for HFF and the maintenance and care of our primary fern display and test garden at the Rhododendron Species Botanical Garden will be sorely missed. Becky and her husband have purchased a farm in Carnation, WA. and we wish her best of luck with her endeavors.

In recent months the HFF has been featured and or referred to in a number of articles both nationally and locally in major publications. Michelle Bundy, the HFF fern curator and the HFF main fern display and test garden were featured on Martha Stewart's Home and Garden Show this past fall. This attention is certainly welcomed and promotes interest in HFF and the endeavors that the foundation is dedicated to.

The focus of the HFF Educational Booth at the Northwest Flower and Garden Show, held this past February, was northwest native ferns. Numerous visitors stopped by

showing an increasing interest in ferns, and in growing ferns in their gardens. HFF provided membership brochures, educational information on recommended ferns that do well in our area, where to buy ferns, information on fern culture, and a flyer advertising the upcoming Fern Festival. This venue is always a pleasure to attend.

The last HFF Board meeting was held at the Bellevue Botanical Garden. We requested from Jerry Nissely, assistant director of the Bellevue Parks Dept., an update on the present position on the implementation of the master plan, which was to include a future fern display garden. Due to budgetary constraints little has been done in this regard and little seems to be on the agenda in the near future. We resumed our regular board meeting and then did our annual grooming of the initial ferns that foundation member planted in 1995.

The HFF Habitat Garden that was installed at the Washington Park Arboretum this past October has received much praise for its design and installation. Two-hundred ferns representing sixty fern species and varieties including another thirty varieties of companion plants in a landscaped setting, showcased on the very limited space of fifty-seven feet by six, was a challenging task. The cooperative efforts of the HFF board and members in taking this challenge to fulfillment has been a gratifying experience (*...with much credit due to John...ed*). The HFF board has been requested to give a class on ferns and fern gardening at the Graham Visitor's Center at the Arboretum on May 15th at 9:30 AM. (For further information see www.urbanhort.org or contact Sue Nicol at 206 543-3883). Numerous visitors have already seen this display garden with 1500 brochures describing this garden given out in the first three months, and that was in the winter! The garden will well advertise the HFF.

Take advantage of some spare time to search out the ferns in your gardens, observe them closely as they awaken and rise up from their winter's sleep. Their remarkable emergence as their croziers unfurl to fully expanded fronds in such a short period of time is a wonder to behold. Happy fern gardening.

Best regards,

John van den Meerendonk



In Memoriam

We are sorry to report that Ruth Hofmann, recording secretary for the HFF for many years, passed away on Feb. 13, 2004. Our sincerest condolences to her family. She will be sorely missed.

Memorials

Helpline House, Bainbridge Island

In memory of Ruth Hofmann

With thanks from the Hardy Fern Foundation

"Best of the West"

Part II - Field Trips

Bill Plummer - Painted Post, NY

Day 2

Perry Creek Western Cascades

Today we are to go to Perry Creek a federally designated Research Natural Area in the Cascade Mountains. After a breakfast in the dining hall we board the buses at 8:30 and meet our driver, Jerry Little, who will be with us for the entire duration of our excursions. With everyone on board and with Bors Vesterby and Richie Steffen leading the way we cross Lake Washington on the floating bridge and get on an Interstate heading north. Then it's off on state roads past Lake Stevens and on to Granite Falls. We then take the Mountain Highway and a rest stop at the Verlot Ranger Station before proceeding. Some 15 miles later we turn off on the Perry Creek Road and proceed up to the trailhead. We all pile out of the buses, collect our box lunches and assemble to await our leaders. To our rear rises a peak with patches of snow visible. Right on the bank at the trailhead was a mat of the delicate *Linnaea borealis*, twinflower. The first part of the trail was dense, dark woods with a lot of deadfall. The trail sign said "Perry Creek Falls 2 miles", but it seemed the longest two miles I have ever hiked! *Polystichum munitum*, the western sword fern, was abundant, as it would be in many other sites during the week. Other *Polystichums* I noted were *P. lonchitis*, the mountain holly fern, and *P. andersonii*, identified by the bud on the tip of the frond. We come across a large clump of the western maidenhair, *Adiantum aleuticum*, differing mainly from *Adiantum pedatum* in the shape of the fronds. Two familiar ferns were *Cystopteris fragilis*, fragile fern, and *Gymnocarpium dryopteris*, the northern oak fern. Whereas my oak ferns only grow a few inches tall, those we say in the northwest were larger in all aspects. After hiking and botanizing in the woods for a period of time we came to a more open area with large boulders and with the valley quite steep on both sides. Here a few plants of leathery grape fern, *Botrychium multifidum* were found as well as a number of *Cryptogramma acrostichoides*, American parsley fern. One was nestled quite exposed among a group of large rocks. But the valley runs east-west and we are on the north-facing slope so the parsley fern never gets a blast of the sun.

A species completely new to me was *Huperzia chinensis*, Pacific fir-moss, in the Lycopodiaceae. Not content to stay on the trail the mountain goats among us are botanizing above and below the trail. At one of these sites Patrick Acock, Bors Vesterby and Martin Rickard were below looking at something on a big boulder with Robert Sykes perched atop. It was almost noon and this looked like as good a place as any to open our box of goodies so we did just that. After lunch it was onward and upward for more botanizing with Perry Creek Falls as our destination. The entire hillside seemed to be one big rock pile and the path was rocky and required diligence in planting one's feet. The views were spectacular and at many places on the opposite wall of the valley evidence of avalanches could be seen. We crossed a few streams that came down our side and at one stretch traversed through a vast groundcovering of lady fern, *Athyrium filix-femina* with fronds fully five and six feet long. Along the path in one area there were two

plants of *Actaea rubra* the red baneberry, but one had white seeds. For some distance below the path was Hercules Club, with its red fruit. Another red-fruited bush was the western elderberry, *Sambucus racemosa*. Meanwhile my old muscles were getting weary and at one point I was about to turn back, but the next group of ferners swept me along. The view of the falls was well worth the hike. After a short welcome respite, I headed back so I would not have to hurry, could enjoy the views and be able to place my wobbly legs firmly on solid ground. Besides enjoying the sight of ferns, both familiar and unfamiliar, I also found pleasure in seeing the western columbine, *Aquilegia formosa* and a lovely blue penstemon. Missed on the way up was a colony of lichen, *Cladonia bellidiflora* British soldiers, on a moss-covered boulder just off the trail. A tree leaning over the trail had a number of *Polypodium glycyrrhiza* growing on the mossy trunk. Back at the trailhead I lay down to rest my weary bones. When all are back we get organized to board the bus and head back to the university and supper. Nobody knows for sure, but the general consensus is the dining room closes at 6:30. On the road back out of the park John Scott sees some Equisetums and calls to me, sitting in front, to alert Jerry so he can stop the bus and I can retrieve a sample for John. We stop and Bors goes merrily on wondering why we have stopped. We get a sample and take off again. A short ways down there is Bors waiting for us. After a quick stop at the ranger station for those in need we're heading south again. When we get on the Interstate, Jerry puts the metal to the pedal as he doesn't want to pick up dinner for the lot of us. We make it back in time and learn that the dining room is open until 7:00. End of the second day.



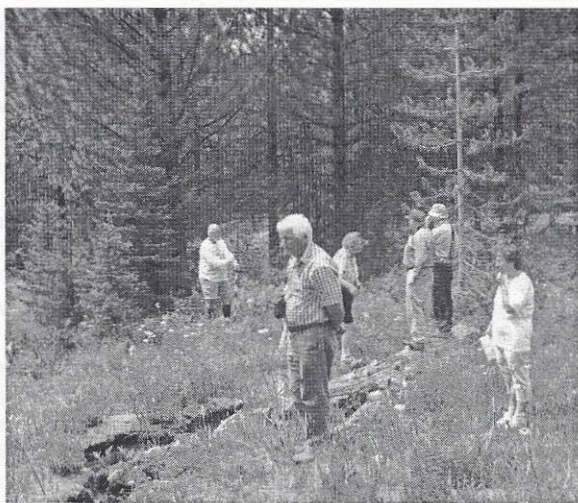
Adiantum aleuticum, Perry Creek. Photo by Bill Plummer.

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Day 5

North Fork of the
Teanaway River
Eastern Cascades

Leaving Leavenworth we head south over Blewett Pass at a mere 4071 ft. (1205 m), with a sign that warns that the pass may be closed in winter. We find the turnoff for Teanaway and head up a macadam road, which after about ten minutes changes to a dirt road as we head up the to the North fork of the Teanaway



Bog area, North Fork of the Teanaway,
Photo by Bill Plummer.

River. After another twenty minutes or so we cross a creek and pull over to await Dr. Art Kruckeberg. Lo and behold, there is a van behind us and Professor Kruckeberg and two of his associates pile out and join us. On this dry rocky slope there are ferns growing in the protection of the rocks. Robert Sykes clammers up the slope to get a better look at *Polystichum lemmonii* while Art points out that this fern found almost exclusively on serpentine soils, is one of the best indicators of serpentine. In addition to the protection of the boulders, the old fronds form a dense mat providing still more protection in this dry environment. Also growing on this slope is another indicator of serpentine soils, *Aspidotis densa* with its very distinctive fronds. We board the bus, follow Art's van to a picnic spot, and find a table. Art pulls out a geological map of the area. He points out where we are and notes the various soil types along the North Teanaway River and their effects likely to be found on the vegetation. We learn that the toxic serpentine soils are very high in iron and magnesium, high in heavy metals, but low in calcium and potassium. Some plants have evolved and adapted to such soils, but may also be found on other soils where there is little or no competition from other plants.

After lunch we head across the road to an open wooded area of Ponderosa pine, *Pinus ponderosa* and western white pine. Here we find more *Polystichum lemmonii* and *Aspidotis densa*. There is a small rapid-flowing stream coming off the hill. One side of the stream is quite dry with sparse vegetation. I spot an ericaceous-looking low-growing plant and then over by the stream *Rhododendron albiflorum*. Bordering the stream the vegetation is quite lush with ferns, especially *Pteridium aquilinum*, mosses, grasses and thistle-like plants. Venturing further on the other side, we come to a swampy area replete with sphagnum mosses and a vast expanse of the serpentine form of *Adiantum aleuticum*. We're also enticed by a host of flowering plants including an abundance of the white bog-orchid, *Habenaria dilatata*. We enthused over the first one we saw and then there were scores. The brilliant red of *Castilleja miniata*, Scarlet paintbrush and the deep

blue of *Gentiana calycosa*, mountain bog gentian really stood out in the bog. Another blue was *Campanula rotundifolia*, Scottish bluebell that contrasted with the white *Erigeron peregrinus*, sub-alpine daisy. *Dodecatheon jeffreyi*, shooting star was not in flower, but the huge clumps made for an impressive display. Towering over all was *Angelica arguta*, Lyall's angelica.

Then it's up to the trailhead for more botanizing. Dozens of cars are parked on the circle and dozens more on the sides of the road, a horse trailer among them with four tethered horses. We head up the trail. Looking back, I take in the large craggy mountain on the opposite side of the trailhead. John Scott also takes a moment to look back and photograph the scene. On the hillside we come across a large clump of *Pyrola secunda*, the one-sided evergreen, nestled against a moss-covered boulder. We find two other *Pyrola*, *P. asarifolia*, common pink wintergreen and *Pyrola picta*, the white-veined *Pyrola*. Growing on the slope among mosses is the blue-flowering *Penstemon serrulatus*, the Cascade Penstemon and then the red cliff Penstemon, *Penstemon davidsonii* forming a small mat among the rocks. Many of the group scrambled to the top of the rocky penstemon outcrop and to find withered specimens of *Cheilanthes gracillima* and *Selaginella densa*. Others found *Cryptogramma acrostichooides* amongst the boulders. The gushing mountain stream to our right as we descend is fascinating to watch as it winds its way a down among the boulders forming small pools and then a low waterfall. Back at the bus we head down the hill, past our luncheon spot, past our meeting spot by the bridge finally reaching blacktop and then I 90. Then it's full speed ahead as we head over Snoqualmie Pass and on to Seattle and Terry Lander Hall.

Christian Kohout at
Mt. Rainier.

Photo by Bill Plummer.



Day 7

Mount Rainier

We see Mt. Rainier from the University of Washington campus, from the bridges as we cross Lake Washington and whenever we've taken a ferry over Puget Sound. At 14,411 ft (4394 m.), it dominates the skyline. Now, today, we will be encircling it as we head southeast to Mt. Tacoma (aka Mt. Tahoma), the Indian name for this glacier-clad mountain. Two hours later, we enter the park from the north and pull over to get a glimpse of the mountain over a conifer-clad ridge. The land drops steeply to a creek far below and then climbs up to a ridge. We catch sight of alpine meadows and rocky protuberances seemingly too steep for plant life. We stop by a creek and there is a carpet of the glacial lily, *Erythronium montanum* sweeping up the hillside. Our first extended stop is at the

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Grove of the Patriarch Trees. We walk down a wide well traveled trail built on the side of the mountain with steep slopes to the left and the right. In one spot, a massive trunk has fallen over the path, partially blocking the trail. Tall dead snags are seen along the trail with the woodland *Dryopteris expansa* and *Polystichum andersonii*. The ever-present *Polystichum munitum* is abundant on the hillsides. In one area there is a beautiful lichen and nearby a *Botrychium lanceolatum*. Further on we cross the stream on a suspension bridge. The Craddocks have gotten there first and Linda has her shoes off and is wading in the water – water that must be ice cold. On the far side there is an expanse of *Gymnocarpium dryopteris* now being described as *G. disjuncta* although most of the group finds this differentiation confusing. At trail's end we come to the "Patriarchs". A loop boardwalk meanders among these ancient trees. In front of two huge firs, a wide platform has been built perfect for photo ops and Alan Ogden poses appropriately. Next we come to the Patriarch of the Patriarchs, *Pseudotsuga menziesii* and here the boardwalk completely encircles its mammoth trunk. On our way back we spot another *Botrychium*, *B. multifidum*.

Back on the road the bus stops and Patrick Acock is across the road and halfway up the slope after a *Polypodium* growing among the boulders on the hillside. Several miles along we stop for another photo op and a beautiful view of Rainier with the quiet Reflection Lake in the foreground. The opposite bank is lush with vegetation thanks to the abundant moisture. There are glacial lilies, *Erythronium montanum*, a large mass of Indian Paintbrush, *Castilleja parviflora*, a huge clump of lupines, *Lupinus latifolius* and a colony of *Dodecatheon jeffreyi* shooting stars in a lovely shade of bluish-purple. Not to be outdone is the Helleborine Orchis, *Epipactis gigantea*, with its big wide leaves and tall flower stalk. Unfortunately, we are a week too early to see it in bloom.

Our next stop is Paradise. While the rest of the group goes to the scheduled area, The Kohouts and I head up the mountain. The path is steep and the sun is hot causing me to stop frequently. The views along the trail are magnificent, however, and well worth the huffing and puffing. On one side you are looking down on a peaceful grassy valley with groves of conifers. In the other direction you look across another valley to snow covered peaks and ridges. On the way down one whole hillside is covered with glacial lilies with a few paintbrushes scattered randomly among them. Then it is time for "home". We have to leave Paradise and we make our goodbyes to this jewel among mountains.

Days 9 and 10

The Olympic Peninsula

Leaving Jocelyn Horder's garden we board the bus for the Best Western Inn at Port Angeles. After checking in some of us visit the Information Center for the Olympic National Park.

The next day we head for the Hoh River Rain Forest in the Olympic National Park. As we start our tour we have a handout listing some eight ferns for the area. We were to find all of these, *Polystichum munitum*, *Adiantum aleuticum*, *Blechnum spicant*, *Dryopteris expansa*, *Polypodium glycyrrhiza*, *Athyrium filix-femina*, *Pteridium aquilinum* and "*Gymnocarpium dryopteris*". The most impressive feature, however, was the fern ally,



Olympic Rain Forest, Photo by Bill Plummer.

Selaginella oregana which festooned the trees like a southern moss.

We learned from our guide that the Hoh Rain Forest receives some 160 inches (400 cm) of rain a year as the moisture-laden winds from the Pacific encounter the Olympic Mountains. That much rainfall results in lush plant life: ferns, flowers, mosses, epiphytes and immense trees. Dominant trees are Sitka Spruce and Western Hemlock. These trees grow to tremendous heights and girths. When they fall, they leave a big hole in the forest and more often than not a tall standing snag. As the snag decays it provides life for a host of creatures. The fallen trunk as well is soon covered with mosses, ferns and tree seedlings. All along the full length of one of these, we saw dozens of young trees growing on the "nurse" log. Eventually the nurse log rots and we

saw prime examples of trees with roots beginning several feet above the ground. However at times a tree has been weakened; the soil is saturated and the entire tree is uprooted. The one example of this we saw must have been 15-20 feet across with ferns and other plants growing profusely in the top of the root ball, but starting to cultivate the now vertical "bottom" of the ball. The other distinguishing feature of the temperate rain forests is the plant life that goes on above our heads – the mosses hanging from the branches of the Big Leaf Maple and the epiphytes, ferns among them that grow in the canopy of the maples. The forest floor is a dense green carpet of plants. *Polystichum munitum* was especially prolific with abundant moisture and the rich soil of the valley.

Ruby Beach

Leaving the Hoh Rain Forest, we continue our counter clockwise circumnavigation of the Olympic Peninsula, our first stop being Ruby Beach. What a fantastic sight it was as we descend the hundred feet from the parking area to the beach. We encounter a tangled jumble of huge driftwood logs as though some giant was playing pick-up-sticks. Navigating over, around and under this 40 foot wide obstacle course was treacherous and not to be done lightly. There is a tall rocky outcrop of an island just offshore and both on and offshore other rocky crags (sea stacks) which have managed to resist the action of wind and water for eons making for a dramatic scene. On one of these crags, the mountain goats amongst us, Pat Acock and Peter Meegdes scramble up to identify a fern, a *Polypodium* which has found a foothold on this outcrop. Others of us are marveling at

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Spruce burls with *Polypodium scouleri*, Beach one,
Photo by Bill Plummer.

pitted with myriad round holes an inch or so in diameter caused by some creature. As we walk along the beach, Robert Sykes takes off his shoes and wades along beside us in the surf. We come to a tidewater pool and our naturalist looks for animals that live in these pools. He spots a starfish and he and Graham Ackers relate its life to us as our bus driver Jerry stares in amazement.

the grotesque forms carved from the rocks by the elements and still others are off in the woods searching successfully for *Polypodium scouleri* a coastal native.

From Ruby Beach, we proceed to Beach 4 where we team up with a Park Naturalist to learn about life in the tidewater, but first pausing for a group picture of this wild and wooly group. The rocks around us are



L-R Back Row: Jerry Little, Jennifer Ide, Pat Acock, Graham Ackers, Martin Rickard, Lyman Black, Nils Sundquist, Jack Schieber
Middle Row: Richie Steffen, Sylvia Duryee, Alan Ogden, Peter Meegdes, Becky Reimer, Bill Plummer, Michelle Bandy
Front Row: Mick Craddock, Linda Craddock, Christian Kohout, Margit Kohout, Rose Marie Schieber, John Scott, Robert Sykes, Sue Olsen, Joy Neal

Our destination for the night is Kalaloch Lodge situated on a bluff overlooking the Pacific. Accommodations are rustic but welcome. After a hearty meal we relax and enjoy the view of the Pacific as the sun, a glowing ball of fire, colors the western sky orange as it slowly disappears. On the morrow, I go down to the beach and look back as the morning sun brightens the sky. A tall one-sided conifer provides a dramatic example of the direction of the prevailing wind. Where I descended there is a palisade of tree trunks protecting the cliff from erosion. Where there is no protection I find the roots of a tree providing mute evidence of the destructive forces of nature. There are gulls on the beach and someone has erected a sand pyramid on the beach. Climbing back to the top there are Robert, Joy and Becky enjoying the sight and sound of the turf. After a breakfast, we are on our way to another beach, Beach 1. Here we do not go down to the beach, but on this particular headland, virtually all of the Sitka Spruce are sporting burls. We learn that the combination of an insect killing a terminal bud and the salt spray from the Pacific is the likely explanation. These burls provide a nice landing spot for seeds and spores and many of them are adorned with fronds of *Polypodium scolieri*. Many of the spruce look bizarre especially when burls sit virtually on top of one another.

Back on the bus, we head to the Quinault Valley where before lunch we have a chance to take a short or long trail to satisfy our appetite for ferns before lunch in the lodge. As we go along a small ravine we gaze at the other side which is massed with *Polystichum munitum* and *Adiantum aleuticum* along with the native Vine Maple, *Acer circinatum*. Looking down we could see that our side of the creek was equally adorned. Along our trail, we come upon a tree that got its start on the top of a four-foot high tree trunk with its roots snaking down the sides until they reached the forest floor. Only then could it really begin to grow. Farther on, we come upon the root ball of an uprooted tree that is almost completely covered with our old friend, *Polystichum munitum*. The trail is longer than expected. That or the fact that the ferns and other plant life too easily distract us. However, the noon hour is approaching and we hurry on to Quinault Lodge where we are seated in the dining room overlooking Lake Quinault. After lunch, we have some time to explore the lodge inside and outside. Going out on the porch my eye is immediately drawn to the totem-inspired rain gauge, which towers seventeen feet. Shortly it is time to board the bus and leave the Olympic Peninsula, our next stop being Kelso in southern Washington preparatory to tomorrow's ascent of Mount St. Helens.

Day 11

Mt. St. Helens

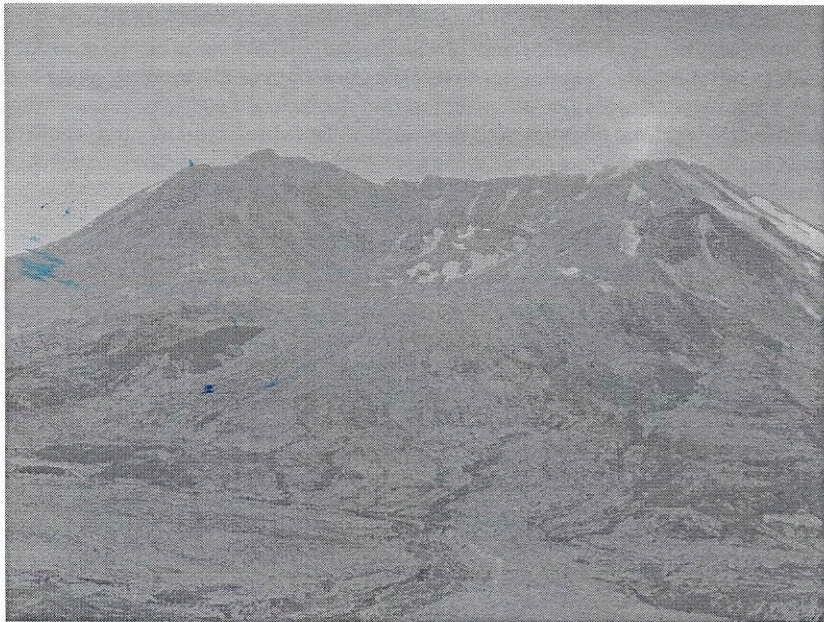
Today, there will be little botanizing as we are about to view the aftermath of the eruption that changed Mt. St. Helens from a beautiful cone-shaped "dormant" volcano to a flat-topped mountain with a glaring hole in its side. Leaving Kelso, we head up the mountain, our first stop being at the Visitors Center. Outside the center in a tall spruce is the nest of a Golden Eagle. We have time to view a movie of the eruption and to walk the nature trail. As we continue up the mountain, we look across the valley to the truncated cone of Mt. St. Helens and the valley below us. Climbing up to Johnston Ridge Observatory, we look down and back where we had come. All looks barren except

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"Best of the West" continued from page 39

there is lush growth along the stream in the valley and in every watercourse that comes off the mountain. Arriving at the Observatory, we pile out of the bus and look across the intervening valley at the gaping hole in the side of the volcano. There is a short trail on the ridge, which affords both a close-up view of the destruction and the recovery, but also a panoramic view of the entire area. There are the remains of stumps from the blast and a yellow-flowering plant on the slope, perhaps hypericum and a lovely violet-blue Penstemon. From the Mt. St. Helens Plant List I learn that there are two ferns found growing within the crater. We would expect to find *Pteridium aquilinum*, Bracken fern, but perhaps not *Asplenium viride*, green spleenwort.

On the way off the mountain, we stop at Coldwater Ridge Visitor Center to view a lake created by the eruption. It is now a lovely blue lake, but on the opposite side, the hill is strewn with trees that received the hot blast from the eruption. Other sections of the hill are forested with trees that were protected from the blast. After a final stop at the Forest Learning Center we head back to Seattle and our farewell dinner. On the bus ride back, Michelle Bundy and Becky Reimer start a cribbage game. Robert Sykes kibbutz's and then he and Michelle play a few games.



Mt. St. Helens, Photo by Bill Plummer.

Final Banquet

We are feeling a bit weary after a day on the mountain and the long bus ride back to Seattle. It is a Friday afternoon and as we get near Tacoma, the evening rush hour builds

up and up. Lyman calls home to tell them we will be late and again as we get near his condominium that we are on our way. As I get off the elevator, I see my wife, Jane waiting for me. She had been in Walla Walla visiting her sisters and had flown to Seattle this afternoon to join me for the banquet. Tomorrow her cousin will pick us up. We will visit the Tacoma Glass Museum and then their home in Steilicoom. While there, we will visit Heronswood Nursery.

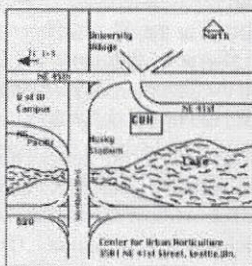
Lyman and Liz are perfect hosts and the dining room at the top of the condominium is light and airy with views across Lake Washington to the Cascade Mountains and Mt. Rainier. Almost as soon as we arrive, we are seated and served a lovely meal. At the conclusion of our banquet, Graham Ackers expresses his appreciation to Sue and all the others who made this fern excursion so special and enjoyable. With Pat Acock's assistance they present some gifts to Sue, with the full approval of all those assembled. Sue graciously accepts the thanks and gifts proffered. Lyman concludes the ceremonies and invites all to visit the fern garden he has established at his new digs. Returning to the banquet room we take one last look across Lake Washington toward our final night's resting spot. Looking to the west, the sun low in the sky creates a beautiful sight in the western sky. We make our goodbyes to our hosts and the local contingent, board our bus for the last time and shortly thereafter are deposited at La Quinta in Kirkland. Then it is time to say goodbye to our friends across the pond should we not see them for breakfast. But we do see some once again and once again we wish them a safe trip.



Farewell Banquet, Photo by Pat Kennar.

Fern Festival 2004

Center for Urban Horticulture
3501 NE 41st Street - Seattle



June 4th
June 5th

Fri. June 4th
Plant sale 1:00 - 6:30
Coffee 7 pm Plant sale prior to & post lecture
Lecture 7:30 pm

Ferns & Companion Plants for Woodland Settings

Lecturers: Glenn Withey & Charles Price
Co-curators of the Ed Dunn Garden

\$7.00 non member
\$5.00 members

Sat. June 5th
Plant sale 10:00 - 2:00
Propagation workshop 11:00

Hardy & Exotic Ferns
Companion Plants
Extensive collection of Hostas
Other shade loving plants
Experts on hand to help

Hardy Fern Foundation
P.O. Box 166
Medina, WA. 98039-0166

<http://www.hardyferns.org>

Itinerary for the "Feast in the East - 2005"

Tour of NJ, DE, PA, MD and NY
Sponsored by the British Pteridological Society and
the Hardy Fern Foundation

Contact John D. Scott
55 Hertzog School Road
Mertztown, PA 19539
bps2005@aol.com
<http://hometown.aol.com/myhomepage/index.htm>

Links to site and all forms are available from the website.
Changes will be emailed to all registrants.

Monday, June 27

Best Western Conf. Center Concordville for early arrivals.

John and Margaret Scott will be at the motel early afternoon and will be available by cell phone until 11 pm. Please stop into our hospitality suite after check in.

Day 1 - Tuesday, June 28

Registration 9:00-10:00

Leave Concordville BW 10:30 am

Pine Barrens of NJ

Welcome Dinner 7 pm (BW)

Day 2 - Wednesday, June 29

Springwood (Dr. Richard Lighty's Garden)

Winterthur

Welcome and *Box Lunch*

Ecology Tram Tour / Native fern garden (newly planted 2004)

Tour: English influence on American Furniture or Rare Books & stroll

Concordville BW 6 pm

7:30 Talk: Intro to the Piedmont Flora

Day 3 - Thursday, June 30

Mt. Cuba

Wild areas en route to Longwood

Arrive Longwood 4:45

Welcome - Tour fern walk

Dinner at Longwood Gardens

Fountain Display at dark

Day 4 - Friday, July 1

Tyler Arboretum

Barnes Arboretum

Henry Foundation

Chanticleer Gardens

Dinner Buffet at Radnor Hotel

Talk 8 pm: Pictorial key to PA ferns

continued on page 44

Day 5 - Saturday, July 2

Chester Co., PA serpentine
MD – Susquehanna
Garden of HFF member Jerry Hudgens
Comfort Inn Lancaster, PA
Talk: *Dryopteris*, *Polypodium*, *Asplenium*
OR

Dutch Apple Dinner Theater (Extra fee and reservation)

Day 6 - Sunday, July 3

Lancaster Co., PA
Asiatica Nursery – Lewisbury

Day 7 - Monday, July 4

Berks County
Rockland Botanical Garden (The Scott's – HFF members)
Kutztown Folk Festival
Ox roast dinner 4:30 pm – 7:30

Day 8 - Tuesday, July 5

Nescopeck St. Park
Delaware Water Gap
Suffolk Branch Trail
Poughkeepsie Area Motel

Day 9 - Wednesday, July 6

Cary Arboretum
Bartholomew's Cobble
Mickel's Garden or Tarrytown area
Show and Tell: *BPS/HFF 2003*

Day 10 - Thursday, July 7

Lyndhurst
Brooklyn Botanic Garden
Buck Garden

Day 11 - Friday, July 8

Bowmen's Hill (Wherry Fern Trail)
Schieber's Garden (HFF members)
Morris Arboretum (Fern House)
7 pm: Farewell Dinner

*Saturday, July 9 – The Scott's will stay on for
emergency transport to the airport !!*



Return Slip BPS –HFF Feast in the East 2005

I intend to join the excursion to Philadelphia in 2005.

I enclose a cheque for \$300 per person made payable to John Scott

or

I have sent payment via Paypal (will be acknowledged via email)

I still hope to come.#

I will not be able to participate.

I require a single room (contact John for single room suppliment.

I require a double room.

I have received a copy of the BPS Safety Code.

I would like a list of those with whom I could share.

I will share with -----

Name -----

Address -----

e-mail -----

I agree to show my certificate of insurance to the leader
at the start of the tour and have read the society' Safety Code.

Signed -----

Please return your completed form and deposit to: -

John D. Scott
55 Hertzog School Road
Mertztown, PA 19539 USA

Direct foreign travel questions to: -

Patrick Acock
13 Star Lane
St Mary Cray
Kent
United Kingdom
BR5 3LJ

#Reservations will be on a first come, first served basis, as places are limited.

To account for mail and other contingencies, I will accept emails of intent in assigning priority as long as payment is forthcoming. This form is available on the website.

British Pteridological Society / Hardy Fern Foundation

MID-ATLANTIC STATES EXCURSION JUNE-JULY 2005

SECOND CIRCULAR — March 2004

PROSPECTIVE PARTICIPANTS:

JOHN SCOTT in Pennsylvania is arranging our tour for June 28 – July 8, 2005. John is a director at large of the HHF. As much as possible correspondence will be to John by email at bps2005@aol.com and he will maintain a web site at <http://hometown.aol.com/bps2005/myhomepage/index.htm> All respondents will be placed on an email distribution list and will receive regular updates. So please send a simple email to the above email address stating your interest.

The tentative itinerary is on the reverse of this page. The number of initial respondents to this prospectus and bus arrangements will dictate the size of the group.

HOUSING: All housing will be at first-rate motels. Rooms will be non-smoking and have 2 queen beds unless you indicate otherwise. We will balance the number of moves to limit the daily travel time. Since most of you will be coming from UK/Europe and western US, motel reservations are being made for the day before the tour starts (Monday) and Friday after the farewell dinner.

MEALS: All breakfasts will be either free continental or buffet at the motel. Lunches will generally be box lunches in the field. Dinners that aren't included will be available at the motel or in walking distance.

Pre and Post Excursion: There is a lot to see in Historic Philadelphia and we will add links to things that you show an interest in.

PAYMENTS: Paying in US dollars for the Tour 2005.

I can't accept a credit card payment. But I do have a PAYPAL account.

Anyone can set up a personal account that is secured by a bank account or credit card.

There is no charge for transferring funds, but there is a charge for currency exchange. It is the lowest that I've been able to find and will be used for the Tour.

Payments for the Tour will be in US dollars.

1. Check.
2. International Money Orders in US dollars.
3. PayPal payments to bps2005@aol.com

Check out www.paypal.com for details.

COST: The cost should be comparable to the 2003 "Best of the West, i.e. \$1600 (880 £). Changes will be posted as available.

TRIP DETAILS: We will be traveling by charter bus. Participants will be expected to travel with the group on the bus. For those arriving early or staying on after the tour who wish to rent a car (be sure to have a proper driver's license).

CLOTHING: Weather in the area is generally humid except for showers. The daytime temperature is generally mid to low 80s, though a heat wave up to 95 is possible. Please bring a range of suitable clothing. Shorts, a light jacket and a sweater are all recommended for the area. Some people are paranoid about tick protection and wear full regalia even in the heat of summer. Most of the motels will have a swimming pool, some indoor, so bring a bathing suit if you'd enjoy a dip. Hiking boots are optional.

Polystichum andersonii

Anderson's Holly Fern

James R. Horrocks
Salt Lake City, Utah



Polystichum andersonii, Photo by Bors Vesterby.

This is a denizen of cool, moist climates as found in the Pacific Northwest. It is found from Alaska down through western Canada to Washington, Oregon, and as far east

as portions of Montana. It does not do well in areas where the summer temperatures are high. This may explain its poor showing in eastern North America as well as southern California. The author has attempted it several times in northern Utah but again the low humidity and summer heat make it short-lived.

Anderson's Holly Fern is terrestrial in habit and is often found growing on rocky slopes. It is a magnificent plant with its tall arching fronds growing from a central crown. The fronds can be from two to as much as four feet long. It is presumed to be of hybrid origin between an unknown diploid and *P. munitum* in the wild. *P. andersonii* has also been artificially crossed with a number of other *Polystichums*, including *P. setiferum*, *P. acrostichoides* and with *P. braunii*, the latter forming a huge robust specimen. The author has successfully grown this hybrid in northern Utah for several years. The huge crown is fully four inches across, producing large stately fronds, many of which form buds.

Description: The rhizome is ascending to erect, producing an impressive stand of arching evergreen fronds that can be two to four feet in length. The stipe is about one-sixth the length of the blade with concolorous, rather reddish-brown scales that are slightly toothed and growing at the base on up the rachis. Narrower pale reddish-brown scales are found further up the rachis toward the frond tip. The rachis bears one or more subapical proliferous buds which enlarge as the frond matures and take root in late fall after the frond has reclined against the ground. Large colonies have been formed in this way. The fronds are elliptic-lanceolate with lanceate or lanceate-oblong pinnae that are pinnate-pinnatifid to almost bipinnate, narrowing toward the base. The fronds are evenly tapered to an acute-acuminate apex. The pinnules are adnate or broadly joined to the costae. The indusium is dentate, that is, toothed along the margin.

Culture: As has been mentioned, this species is best grown in cool, damp climes where it does not heat up much in summer. It makes a fine accent plant, attaining a fairly large size in milder climates, although it is considered a medium-sized fern. It can take some sun in its Pacific Northwest home. Barbara Joe Hoshizaki tells us that it "adapts poorly on the East Coast". It would be interesting to see if anyone has had success with it back

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Polystichum andersonii continued from page 49

east. It has never done well in northern Utah but hybrids between it and *P. braunii*, as well as *P. setiferum* have done very well here over several years.

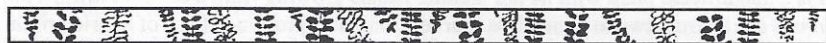
Growing it from buds is best done in late fall when the buds are enlarged. Since the buds do not detach from the leaf, the end of the frond should be cut, washed, and planted with the bud secured to the sterilized potting soil in a small container with a transparent or translucent lid. The bud will begin to grow and when it becomes too tall for the container, the lid should be removed and the container placed in a terrarium or growing tank. A good sized plant can result in about two years. The best time to plant it out in the garden is in the fall, so that it can winter over. The following spring it begins its display which only gets better each year. The magnificent hybrids can be reproduced in the same way. If you have not had good luck with *P. andersonii*, try some of the hybrids, particularly *P. braunii* x *P. andersonii*, if you're lucky enough to find them.

References:

Ferns for American Gardens, (1994) John Mickel, MacMillan Publishing Co., New York

Fern Grower's Manual (2001) Barbara Joe Hoshizaki and Robbin C. Moran, (Revised)
Timber Press, Portland

A Field Manual of the Ferns and Fern Allies of the United States and Canada (1985)
David B. Lellinger, Smithsonian Institution Press, Washington, D.C.



Welcome New Members

Foxfire Farm

Kris Gilbert

Laura Schauss

Tom Stuart

Claudia Tidball

David Traylor

Agris Veismanis

THE HARDY FERN FOUNDATION

QUARTERLY



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Please send your submissions to:
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2003 128th Ave SE,
Bellevue, WA, 98005

Newsletter:

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Assistants: Michelle Bundy
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(cover design)
Karie Hess (inside design)

Ferns in Research - I. The Gametophyte

Joan Eiger Gottlieb
Pittsburgh PA

For those who love to find them in the wild or grow them in gardens and under glass, ferns and allied plants are natural treasures. But, for over 125 years they have also been serious research subjects, helping scientists unravel many mysteries of plant biology. Early German experimenters published a steady stream of elegant work in the late 19th Century, like that of Leitgeb (1878)⁴ who showed that the first division of *Marsilea* zygotes (fertilized eggs) is always parallel to the axis of the archegonium (egg + jacket cells) no matter what gravitational or other conditions were altered.

The pace of experimental activity picked up rapidly in the 20th Century, reaching a peak in the 50's and 60's when the techniques of *in vitro* culture allowed cells, tissues, organs, and even whole plants to be grown under sterile, controlled conditions. Also in those decades an explosion of knowledge about plant hormones (auxins, kinins, gibberellins *et al.*) provided researchers with important substances for the experimental manipulation of normal growth and development. In 1950 Irene Manton⁴ began her pioneering work on the dividing cells in fern sporangia. This produced an enormous database of chromosome numbers and morphologies for 20% of fern species and 75% of fern genera. It also fed later work on hybridization, polyploidy, isozyme and DNA analysis - the quantitative underpinnings of modern fern taxonomy, genetics and evolution.

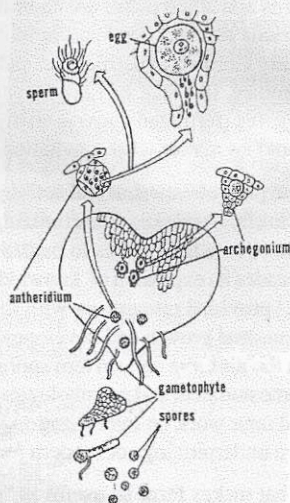
What makes ferns so useful as "guinea pigs" in our attempts to understand how living organisms "work"?

- Ferns and allied plants have both ancestral and parallel evolutionary histories with seed plants. Within their genomes lie most of the adaptive strategies that made the higher plants so successful on land.
- Ferns have a "split personality" life cycle with two separate, independent, multicellular plants – gametophytes and sporophytes – that are easily grown from spores and zygotes respectively.
- Fern gametophytes are small, with simple, but interesting growth patterns and relatively large cells. They mature quickly and are sensitive and quick to react to experimental stimuli.
- Fern sporophytes are sturdy – able to withstand surgical procedures (dissection, division, cellular separation, chemical treatment) and still remain viable.
- Ferns are easy to culture in liquid or agar-solidified media on simple mineral salts plus a little sugar, unlike seed plants that often require complex organic additives (*e.g.* coconut milk). Dyer (1979)¹ points out that young fern gametophytes are among the simplest photosynthetic organisms that can develop normally in tissue cultures. Statistically significant numbers can be grown in dishes or tubes, much as microbiologists grow bacteria and fungi.
- Ferns are quite diverse – tiny species to tree-sized, tropical denizens to desert dwellers, simple-leafed to intricately pinnate, homosporous (spores of uniform, small size and development) or heterosporous (spores of two distinct sizes, the small ones developing as male and the large ones as female gametophytes) - but numerically manageable (about 12,000 species worldwide) as opposed to flowering plants (250,000+).

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Ferns in Research *continued from page 49*

This article will sample only a few of the many research areas to which gametophytes of ferns and their allies have contributed over the past 50+ years. The most thorough and meticulous studies of these diminutive plants were done over many decades by Atkinson and Stokey (1964 summary)⁴. The typical fern gametophyte is a “minimalist” organism. Its cells normally have one set of chromosomes - the haploid or “n” number of the species. At maturity its photosynthetic thallus (simple plant body) looks like a scrap of green tissue paper about the size of a pinky fingernail. It is only one or a few cells thick, 2-dimensional, with a terminal meristem notched between expanding lobes; the whole thing becoming heart-shaped, suggestive of its function – sexual reproduction. This flimsy, but sexy little plant starts out even simpler as a chain of cells (the protonema) emerging from a spore. Cell division in a second plane soon produces a wider, strap-shaped prothallus. Finally, a meristem area of permanently dividing cells is established apically or laterally. Daughter cells from this area enlarge as they mature, overtopping the meristem as broadening flanks. Rhizoids (single cell outgrowths) for anchorage and absorption of water and minerals plus a variety of multicellular hairs grow down toward the substrate from the underside of the thallus.



Typical fern gametophyte development.

Variation is extensive, reflecting a long evolutionary history, and includes,

- ribbon-shaped thalli in ferns like *Osmunda* and *Hymenophyllum* that may branch and proliferate, but do not become cordate.
- cylindrical or tuberous, non-green (fungi-dependent), subterranean gametophytes in *Psilotum*, *Huperzia*, *Lycopodium*, *Botrychium* etc.
- endosporic gametophytes that develop to maturity inside the spore wall, opening only when sperms or eggs are ripe, in heterosporous ferns (e.g. *Marsilea*, *Azolla*) and fern allies (*Selaginella*, *Isoetes*).
- spores and gametophytes from fertile hybrids (allopolyploids) or spontaneous mutations that have more than one complete sets of chromosomes per cell (e.g. 2n, 3n, 4n).
- aposporous (without spores) gametophytes produced directly as outgrowths of sporophyte tissues (e.g. detached leaves of sporplings in culture or aging, mature, frond segments that touch damp soil), possessing the same chromosome level as the sporophyte.

Returning to typical fern gametophytes, sperms are produced on very young plants. They are enclosed by 3 or 4 cells making up a protective jacket, an important innovation for a land plant, the whole structure known as an antheridium. Antheridia are found abundantly among rhizoids on the lower surface of the cordate thallus or along the edges

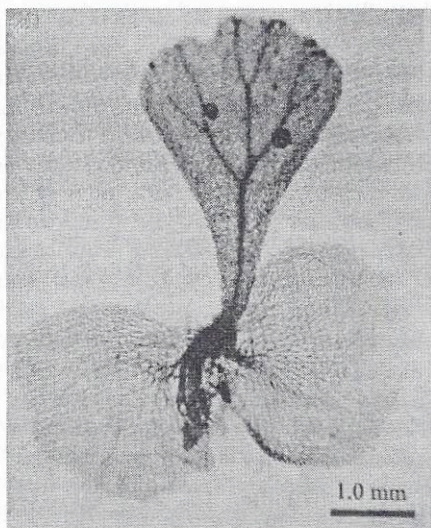
of young prothalli. Archegonia, single eggs at the base of vase-shaped cellular jackets, form later near the metabolically active meristematic notch of mature thalli. Most homosporous ferns have bisexual gametophytes that bear sperms and eggs on the same thallus, but in a time-spaced pattern that favors cross-fertilization with neighboring plants. However, there is a lot of variation and environmental plasticity in fertilization patterns. Large, flagellated sperms escape through antheridial cap cells and swim in films of rain water to archegonia with ripe eggs. In laboratory experiments L-malic acid works as a lure for bracken (*Pteridium*) sperms, but actual directional stimuli in nature have not yet been identified. Fertilization results in the first cell – the diploid (2n) zygote - of the sporophyte generation. Its fate and its contributions to research will be considered in the second article of this series. Suffice it to mention here that the fertilized egg begins its development on the underside of its parent gametophyte, attached to, and initially dependent on the archegonium.

Research focused on spores and gametophytes has been well summarized by Raghavan (1989)⁴. The spore is arguably the first cell of the gametophyte generation, and, in fact, the “green” spores of *Osmunda* and *Equisetum*, which are notoriously short-lived, contain several-celled young gametophytes already developing and photosynthesizing prior to shedding. They are not designed for dormancy, but the spores of most ferns can and do survive for months or years. Refrigeration or freezing will extend viability even longer by slowing desiccation, a serious problem for a spore, which is, after all, only a single cell, albeit with a multi-layered wall reinforced by a light-sensitive, carotenoid-containing polymer.

To capsulize a large body of research on the physiology of germination and gametophyte growth, the same visible red (long wavelength) light that induces spore sprouting is also required by many seeds, and the same phytochrome pigment is involved in both systems. It is the way reproductive cells “sense” closeness to the surface of a substrate with enough incident light to support photosynthesis, providing the energy for growth. In ferns filamentous growth, due mainly to cell elongation, occurs, and can be prolonged, in that same red light, while planar growth, resulting from rapid cell division, is a response to blue (short wavelength) light. Both growth forms are related to the movement and orientation of microtubules and the specific protein tubulin. Light sensitivity also produces gametophyte “bending” growth toward an asymmetrical light source as is seen in the seedlings of higher plants and called positive phototropism. It is mediated in both groups by light-induced redistribution of hormones like indole-acetic acid [IAA], an auxin or growth hormone produced by young, dividing cells, e.g. meristems. Whittier *et al.* (1973)⁴ showed that spores of *Botrychium* and other ferns with subterranean, mycorrhizal gametophytes germinate in culture only after relatively long periods of complete darkness, as expected, although they will grow subsequently in the light. Experimental work confirms that light, crowding, temperature, pH and water form a complex array of interacting conditions that assure spore germination only under survival conditions.

Farlow (1874)⁴ observed that some gametophytes of *Pteris cretica* had no archegonia but produced thick, hairy “cushions” near the meristem, followed by sporophytic “outgrowths” – a leaf first, followed by a root and later a stem. DeBary (1878)⁴ coined

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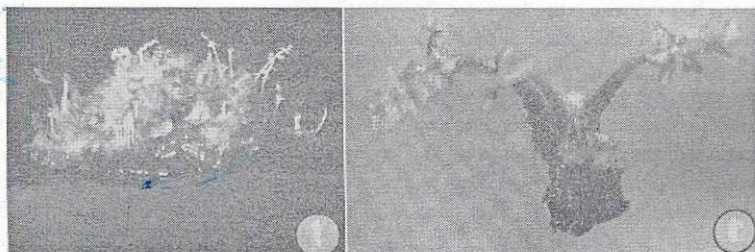


Apogamous sporophyte of *Cheilanthes tomentosa* with a leaf and root. (From Whittier, 1965⁴).

the term apogamy (without gametes) to describe this anomalous form of asexual reproduction. Since then apogamy has been uncovered in many genera and dozens of species, particularly among the desert ferns *Cheilanthes*, *Pellaea*, *Notholaena* and *Pityrogramma*. It is an asexual reproductive strategy well suited to harsh habitats where light intensity is high and water, required by motile sperms, is unreliable and quick to evaporate. Some fern gametophytes are obligately apogamous, having imperfect or dysfunctional sex organs or being of hybrid/allopolyploid origin with $2n$ or $4n$ genomes. Others may use apogamy as a backup to failed fertilization, e.g. in times of drought, the sprouts arising from cells at the base of the archegonium.

Apogamy can also be induced experimentally in tissue cultures of most homosporous ferns. Even the subterranean gametophytes of *Botrychium* and the endosporic ones of the heterosporous *Marsilea* have been

Apogamy can also be induced experimentally in tissue cultures of most homosporous ferns. Even the subterranean gametophytes of *Botrychium* and the endosporic ones of the heterosporous *Marsilea* have been



(Left) Colony of *Pteridium* gametophytes with apogamous sporophytes in induced in culture with 2.5% glucose. (Right) Close-up of an apogamous sporophyte with pinnate fronds after 15 weeks in culture. (From Whittier, 1964⁴).

“coaxed” into apogamy by researchers. Work by Whittier *et al.* (1960-1971)⁴, mainly on *Pteridium*, indicates that several specific factors are transformative, especially at the initiation phase:

- light (e.g. 12-hour photoperiods and 25+ ft.c. intensity)
- sugars (e.g. glucose, sucrose, fructose) at 2.5% in the mineral salt culture medium (below osmotic thresholds)
- hormones (e.g. ethylene gas, IAA, gibberellic acid [GA]).

It appears that high nutritional states and some hormones can “tweak” the gametophyte genome into full activation, pushing ordinary thallus cells to express their pluripotency

by producing tissues and organs of the more complex sporophyte plant body, including tracheids (specialized water conducting cells). The evidence does indicate that gametophytes with high gene "doses" ($2n$ or $4n$) are more likely to produce apogamous offspring, while typical sexual reproduction is more usual for gametophytes with the "n" genome. Apogamy, and its sporophyte counterpart – apospory, remind us that the two alternating plants of the fern life cycle are not as different from each other as their superficial appearances or chromosome multiples might suggest. In suitable environmental or chromosomal situations each generation can form the other from ordinary body cells, bypassing spores and gametes entirely!

Döpp (1950)⁴ and Näf (1979)⁴ showed that gametophyte cells are sensitive to pheromonal chemicals, now called "antheridiogens" that are produced by older, archegoniate



Young, cultured gametophytes of *Ceratopteris* with very abundant antheridia, (From Sayers & Hamilton, 1995⁵).

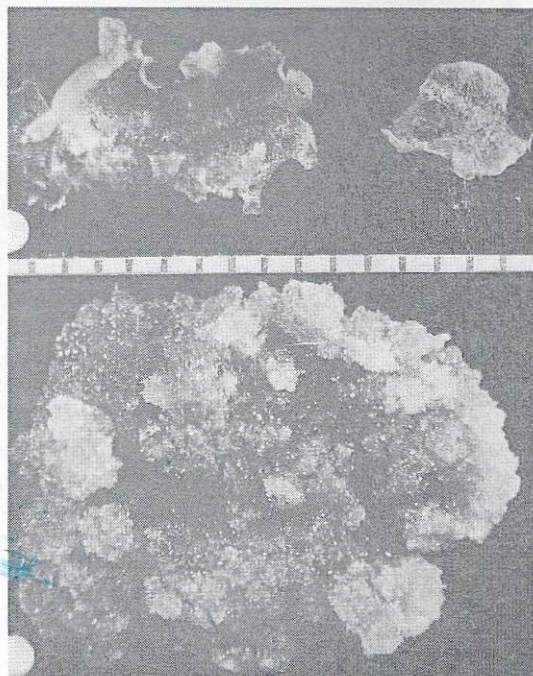
thalli. The presence of these substances in the environment of young prothalli growing nearby induces early production of antheridia. In many cases these sex stimulants are not species specific; antheridiogen extracts from *Pteridium aquilinum* cultures can induce maleness in gametophytes of *Dryopteris filix-mas*, and vice versa. These extracts can also be used to stimulate spore germination in the dark, with resultant 2-3 cell protonemal threads that have one or two antheridia and fully functional sperms. In nature this may be a way to "rescue" lost spores below the lighted surface, signaling that older, egg-ready thalli are in the area. Antheridiogens are water-soluble, active at very low concentrations and gibberellin-like in structure. They belong to a group of chemicals called diterpenes that are important in fern biochemistry as well as that of seed plants. Older gametophytes continue producing antheridiogen, but their own sensitivity to it drops sharply as high metabolic activity at the meristem end favors archegonial development. This may help explain the alternating production of sperms and eggs that enhances out-crossing.

Sensitivity to antheridiogens may also contribute to the relatively high rates of hybridization in some fern genera. For example, gametophytes of *Cystopteris protrusa*, *C. bulbifera*, and their beautiful hybrid *C. tennesseensis* cultured on a medium containing *Pteridium* antheridiogen show high, low and intermediate sensitivity respectively (Haufler *et al.*, 1990)². Where the two parent species grow in the same area in nature *C. protrusa* thalli might thus be mainly male and those of *C. bulbifera* mostly female, setting up a situation facilitating hybridization. Isozyme studies of *C. tennesseensis* populations do, indeed, indicate a lot of genetic diversity, pointing to recurrent, frequent hybridiza-

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Ferns in Research *continued from page 53*

tion events, as opposed to asexual propagation from one or a few rare couplings between the parent species. Taking it one step further, lots of genetically diverse hybrids makes allopolyploidy (spontaneous doubling of a hybrid's genome) more likely, avoiding abortive spores and restoring fertility to at least some hybrids. Chromosomes of hybrids are usually unable to form pairs as required for meiosis and spore formation because they are not genetically and structurally compatible. But, if the chromosomes are doubled as



(Top) Normal gametophytes of *Pteridium* cultured in vitro. (Bottom) Tumor isolated from a culture of *Pteridium* gametophytes. (From Partanen, 1980³).

they are in polyploids, the duplicates can "find" matching partners and create viable spores. It is important to point out that laboratory results do not automatically translate to the wild. In other words what can happen in a Petri dish may not be what is actually happening in nature.

It is time to end with a tale of tumors in ferns that helps underscore the commonality of life, especially at cellular/molecular levels. Steeves *et al.* (1955)⁴ isolated occasional tumor-like variants (clumps of undifferentiated cells) from cultures of young *Pteridium* gametophytes. Partanen *et al.* (1955 - 60)⁴ analyzed the chromosomal DNA of these variants and found that they started as expected haploids (n), but progressed to an average tetraploid ($4n$) level by endoreduplication (repeated DNA doubling without the usual follow-on cell division). Using ionizing radiation these researchers were able to demonstrate that the numbers of tumors rose linearly with increasing radiation dose, up to a lethal level. Tumors could be isolated and sub-cultured indefinitely - one strain for over 30 years. Even single cells and naked protoplasts (cells without walls) from these strains grew into tumors, indicating a permanent, mutational change. Normal, 2-dimensional thallus growth was replaced by a 3-dimensional, irregular ball called a callus. Chemicals were screened that might "cure" or inhibit tumor formation in irradiated spores, and a single amino acid - L-methionine - was found to reduce tumor numbers by 85% compared with controls on media lacking methionine. How prescient that was, knowing, as we do now, that animal cancers are characterized as "hypomethylated" - having low levels of methyl (CH_3) radicals.

For an ephemeral, pint-sized plant, the fern gametophyte has made significant contributions to biology. It turns out to be a malleable system in the hands of skilled, patient scientists seeking to uncover its secrets. As Dyer (1979)¹ says, "...a world without ferns would be a great deal poorer one for experimental biology. (*Their*) study has already brought rich rewards in...understanding...their own unique characteristics and those they share with other plants..." Try growing some from spores or finding them next time you are out hiking. The late Michael Cousens wrote (1987), "There is a special Zen to finding gametophytes (*in nature*). First, you must be convinced that they are there." Get down on your hands and knees in the woods. Search those damp, exposed clay banks. The thalli you find will win over your heart and remind you how much these elusive "pixies" have taught us about life.

REFERENCES:

¹Dyer, A.F. (ed.), 1979. *The Experimental Biology of Ferns.*, N.Y., Academic Press

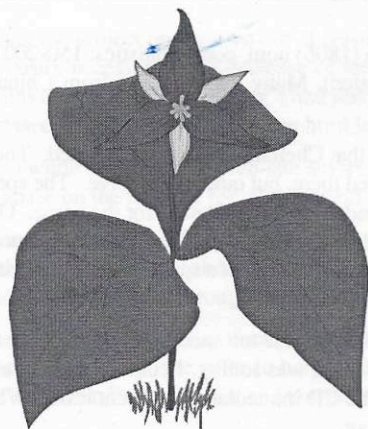
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³Partanen, C.R., 1980. Geographic Variation in the Frequency of Spontaneous Tumors in Fern Gametophytes, *Nat'l. Geog. Soc. Research Reports*, 12:535.

⁴Raghavan, V., 1989. *Developmental Biology of Fern Gametophytes*, N.Y., Cambridge Univ. Press (includes an excellent, complete bibliography).

⁵Sayers, A. & R.G. Hamilton, 1995. The Effect of Neighbors on Gametophyte Development in *Ceratopteris richardii*, *Amer. Fern Journal* 85(2):47

⁶Schneller, J.J. *et al.*, 1990. Antheridiogens and Natural Gametophyte Populations, *Amer. Fern Journal* 80(4):143



Happy Spring!

World Ferns on CDROM

By Dr. Michael Hassler and Brian Swale

Reviewed by Robin Halley and Robert Halley

I was doing an Internet search on "fern checklists" and the very first entry on the page of search returns was "Checklist of Ferns of the World - World Ferns and Fern Allies ...". I have to tell you that my experience with sites that promise anything "of the world" has been spotty at best, so I clicked on the link to the page with cynicism in my heart.

The first thing that shows up on the page is a gorgeous picture of *Histiopteris incisa* and an explanation that the site is, indeed, supposed to be as complete a collection as possible of all the ferns of the world. The pages were compiled as a work of love (purely volunteer) by Brian Swale of New Zealand and Michael Hassler of Germany. Neither is a professional pteridologist (see the appended story of the evolution of the collection) so there can be issues with clumping and/or splitting of families, tribes, and genera of ferns and there will always be an issue with keeping the pages updated with findings and recommendations from the latest botanic literature, but this is a tremendous resource.

I started looking through the site and was amazed right away with the type and amount of information available in the collection. Brian and Michael present 3 classes of ferns in 19 orders and 58 families. Their total list of ferns includes 316 genera, 12838 species and 501 hybrids. Monumental! Even so, there are omissions. My father, Bob Halley, and I have found that a number of North American fern species are not listed. Brian is embarrassed that they missed the entire contents of the *Flora of North America*, Vol. 2 and is (I believe) attempting to catch up on that.

At each level of the checklist (class, family, etc.), the CD tabulates the number of genera listed, a species estimate for the world, and the number of species and the number of hybrids listed in the checklist. When you select a genus name, the CD opens a new web page that provides class, order, and family botanic information in addition to genus and species information. An examples of genus information for *Cheilanthes* shows the following:

036.1001 *Cheilanthes* Sw.; Syn. Fil. 5: 126 (1806) nom. cons. Statistics: 150-200 spp. worldwide [203 species and 14 hybrids listed]. Many microspecies from China are probably invalid or nomina nuda.

The page goes on to list 19 alternate names that *Cheilanthes* have been called. The list is still not complete as *Aspidotis* is not named there, but quite impressive. The species list follows with at least the species name and a literature citation for the name. Occasionally, you also get the common or trivial name and a list of any known subspecies. The list does not provide a historical view into the naming of a species or alternate names at the species level.

After I read the site disclaimer about how the site was too successful and that the total information would be limited to a CD that Brian was selling, I contacted Brian about getting a CD to check out. Brian made up the CD immediately and sent it off. When I got it, I immediately opened it and tried it out.

The CD and the web site work much the same way. In order to find species-specific information, you need to know a specific name of a class, genus, and species. To shortcut the process, you can use the "Find" feature on your browser to go directly to a word or you can just browse until you find what you want...that's fun, too. On the opening page you can only "find" the various genera. Press 'Ctrl-F' and enter the name of the genus to be found and you will find all strings on the HTML page that contain the letters you entered. Choose the genus you want and a single click will open up the list and you can go on to find the species. Press 'Ctrl-F' and enter a species name and again you will get every name that includes your letters. Since the species are listed alphabetically it may be easier just to hunt for the species name.

If you want to just dip into this list log on to <http://homepages.caverock.net.nz/~bj/fern/> Here you will get the full list (at least the original list), but it will not include the valuable information on synonyms and particularly geographic distribution. These entries are only on the disc.

I have found this tool very useful when I am given the name of a fern and I am asked to see what I can find. It is also useful to look up alternate names and possible geographical distributions for a fern as a basis for further research. I have often had the name of a fern but have not known in what book to look because I didn't know from where the fern came. This CD makes it easy because it lists the full geographic distributions for each genus. Then too, different authors will often address the same fern by a different synonym, usually depending on when the book was written. Here on the CD you will find a complete list of synonyms for each entry.

I recommend this tool to anyone who is interested in ferns at the Latin name level. I only wish that Brian and Michael had a funding resource to let them complete the list, keep the list updated, and add images.

The story of how the database was created in the first place is almost more interesting than the CD. Here is a recounting of the tale and information about obtaining your own copy (or copies) as provided by Brian Swale.

I started the project on my own out of frustration at being unable to find a comprehensive, easily accessed world database of ferns anywhere. David Jones' Encyclopaedia contains a mere 700 or so species. I had just started writing my own web pages, and was impressed by the universality of the html language/browser system.

After a while I had my own web-site anyway. The idea came to me that I could put such a database on the Internet for all the world to use.

So I used the books I had, and bought a few more second-hand via the Internet, and in 18 months or so I had listed about 20% of the world ferns. Then I discovered MOBOT, and began to work my way through their records. Also, I found many Internet sites of help.

I was about 25% of the way through the world list when I was approached by Michael, by e-mail.. He made the offer to help, and he had access to some very good botanic libraries; one in Pennsylvania, and two close to his home in SW Germany. I was unsure

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how to respond to his offer, as I soon realized that if he wished he had the means to totally eclipse my efforts. So I decided to accept his offer of help.

Michael is (or was; we have not been in contact for a little while and of course things may have altered in that interval) Sales Manager for a large chemical company, and they were interested in plant chemical compounds. He wished to have a very good understanding of all the plants of the world. By now he has put together a CDROM of all the Orchids of the World, I understand it has images of most of them as well. I do not know what Michael's qualifications are; but he is a person of very great energy and speed. He has written books about the region he lives in, as a search of the Internet reveals.

We came to an agreement that he would assist, and he used his position to gather world-wide information. I was able to supply some that he was unable to obtain. The format he adopted for data layout was superior to my first effort, and I agreed we should use his. The quality of his work output was from the outset designed to be used by professionals - I had personally not aimed that high.

He provided me with the information in document form and I manually coded it all into web-pages. At that time I did not know that later MS Word had the ability to transmogrify text into html; but now I am thankful for that, since the coding I did by hand is much more economical of space and simpler to edit than MS ever could provide. So, I hand coded all 370-odd genera into html pages and linked them to a Classification page as the central menu. The pages were all put up on my web-site in their entirety for people to use freely. However, I soon found that the combination of personal and institutional visitors, and the search engine robots, created such a large volume of downloads that it was costing me an arm and a leg every month to pay for this. The downloads from my site exceeded in volume, the next largest website hosted by my ISP, by several orders of magnitude.

At the same time I found that family commitments required me to find some more income, and I decided to reduce the page content and make the full dataset available only by CDROM, sold from home via e-mail. It was not easy to decide on a price. In the end I decided that since the data would, if printed on paper, make a book of about 400 pages, I should price it at about that of a modest reference book, or two good music CDROMs. \$NZ 70.

As far as I know, despite some relatively small omissions, it is by far the most complete and easily accessed list of all the ferns of the world as seen from a 2-year snap-shot of major world references and some important separate papers. I think it is a world first - that is what I claim anyway.

Now I am getting more interest and it looks as though I may need to upgrade the appearance of the CDs (printing the name etc actually on the CDROM, rather than just writing it with Sharpie pen), as well as setting up other payment options.

My background is that I was raised in a rural New Zealand locality, and from about the age of 11, I was fascinated with ferns and developed a small living collection of local ferns of Southland.. Later, with my job, I obtained a B.Sc. majoring in botany, then went on to study forestry science and get a degree; this was followed by work as a graduate forester. About 25 years ago my childhood interest in ferns was revived and my job enabled me to become more familiar with NZ ferns...

Payment methods. I may have to get set up to deal with credit cards but I am not keen on this option due to the cost. Demand may require it however, if I get more commercial approaches - which thankfully have been few to date.

1) We can process a cheque (check) from any country here in New Zealand.

Please understand it will take 22 working days to process it. My bank here must send it back to your bank for them to confirm it is OK and return it here. That is how the system works. In total including weekends it will take about a month for confirmation to reach me. But the system does work OK; I have used it many times.

2) Also you can transfer funds to my bank account, transfer details of which are:

Bank of New Zealand (BNZ) North End, 100 Lambton Quay, Wellington,
New Zealand.
S.W.I.F.T code BNZNZ22

Email me for the details. Please add a code to show it comes from you.

3) Check or cash sent in a registered envelope.

You might wish to register the letter, for the sake of safety and security.

My postal address is:

Brian Swale
140 Panorama Road
Christchurch 8008
New Zealand
Tel: +64 3 326 7447

4) Payment to my PayPal account (<https://www.paypal.com>). However if you use this option, I ask you add 5% to the cost, since PayPal charge me a significant fee of up to 8% to transfer the money from their USA coffers to my NZ bank account.

I test each CD (on a PC) before dispatch. If the CD itself is faulty on arrival, I replace free of charge. That option has not been needed yet. The way things are going it looks as though I shall have to do a second edition soon to deal with the North America omissions (I cannot for the life of me understand how the Flora was missed - maybe with the use of Lellinger we thought that was it !!), and I may have a shot at entering Barbara Parris's information. I should look to see if I can find a local copy of the USA Flora.

I did set the price of the CDs in New Zealand dollars. For most of my customers around the world this is not a problem (I have customers from the most unlikely places, one

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would think). BUT, the USA dollar is particularly weak at the moment and has been getting weaker by the month for quite some time. This means that while for the rest of the world the \$70 price in NZ dollars has stayed fairly stable when converted to their own currencies, for USA residents it has seemed to get more expensive; which in USA dollar terms it is.

When I started selling the CDs, 100 NZ dollars would buy 42 USA dollars. Now they buy nearly 70 USA dollars. (Ed. Note: This would make the current cost in US dollars equal about \$50.) While I feel for USA citizens, I remember when the exchange rate about 20 - 30 years ago was 2 US dollars to 1 NZ dollar; 5 years ago it was 70 USA dollars to 100 NZ; and 2 years ago when I was buying stuff from the USA it was 40 USA dollars to 100 NZ dollars. So I am not sure what, if anything, to do about this right now.

Do It Yourself Tree Ferns

Sue Olsen

Bellevue, WA

Encouraged by seven consecutive mild winters and the availability of some reasonably priced *Dicksonia antarctica*s a number of us in the greater Seattle area indulged our tree fern desires in the summer of 2003. We should have known better!!

As I write this on March 20, many a brown frond drapes over the well intended bubble wrap that was hastily applied when our winter temperatures dropped to 18°. Now comes the inevitable wait and wish stage. Whatever the outcome, all is not lost. Sylvia Duryee pointed out a set of instructions in Volume I (page 166) of George Schneider's magnificent *The Book of Choice Ferns*. In describing ingenious ways to grow ferns he writes, "The stems of dead Tree Ferns may also be utilized with advantage in this way: by scooping out the upper part, and filling it with soil, a good-sized plant may be inserted in the top, while the sides may be planted with young seedlings, which, as shown in our Illustration (Fig. 12), eventually take possession of the whole surface. The best plants adapted for this purpose are the several species of *Davallias*, and of trailing *Acrostichums*, *Nephrolepis*, and some of the *Polypodiums*, all of which, in their natural state, are found growing in a similar way. These ornamental Tree Fern stems, although practically dead, require to be watered, like Tree Ferns, from the top; and to keep the artificial growth upon them in good order, the waterings must be both copious and frequent during the growing season, gradually lessening them as the winter approaches."

I'm not sure that this would be particularly fetching on the 8" trunk of my tree fern, but there is certainly potential for creating a "conversation piece" and for amusing the experts!

The Book of Choice Ferns, George Schneider, L. Upcott Gill, London 1892.



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