Hardy Fern Foundation NEWSLETTER

Editor Sue Olsen • VOLUME 6 NUMBER 3 • SUMMER 1996

President's Message

Sylvia Duryee

Relative? and of interest - possibly! Since some of us may have to deal with a similar scenario, I will tell what has happened in my garden over the last 10 years. Our first tree died 10 years ago. It was a red cedar about 140 years old - unknown cause. Next a large 40 year old hawthorn, then a flowering crab apple died. We began to suspect a problem and remembered the neighbor's heating oil tank which had been emptied 9 years earlier. Consulting a number of specialists and obtaining core samples we learned there was indeed contamination. These first samples were not processed as well as they are today, however they did show oil product at about five feet. Eventually the tank was fully cleaned and filled with concrete slurry. New tests beside and to the bottom of the tank were done showing no contamination. Over this time our loss of trees now reached five chamaecyparis of about 80 years, three mugho pines, and 90% of a large viburnum. We ran more careful test wells to ten feet and in 24 hours had 1 !/2 inch of oil on top of the water. Yes we proved our point at our cost! Since January of this year we have had a backhoe in the space for 2 1/2 months, removed 21 1/2 tons of soil and we still are losing a *Nothofagus dombeyi* and 2/3 of a large pine.

Yes we have a new start. At this time I hope to recreate my shade gardens and find some way to protect my many woodland plants and ferns. Wish me luck and in time perhaps I won't be looking squarely at my neighbor's house that for 25 years we could scarcely see.

Other news - The Fern Festival here was nearly a double success over last year. The keynote speaker, Steve Hootman, gave a most interesting talk at our annual meeting about his collecting trip to China last fall. The following persons were elected to the HFF board for the 1996-97 year: Mayde Anderson, Willanna Bradner, Jack Docter, Sylvia Duryee, Herman Entz, Ruth Hofmann, Anne Holt, Steve Hootman, Otis Hyde, Marshall Majors, Sue Olsen, Jan Pirzio-Biroli, John Putnam, Meredith Smith, and John van den Meerendonk.

Your board is supporting the effort of Dr. Art Kruckeberg, Prof. Emeritus of Botany, University of Washington, to have the Perry Creek drainage in the Mt. Baker/Snoqualmie National Forest area declared a Research Natural Area. (See letter elsewhere in this issue.) We should like to encourage our members to write letters to Mr. Dennis Bschor supporting this proposal.

The A.I.B.S. meeting is scheduled here in August. We hope some HFF members will join in on the tours and attend the HFF reception at the University of Washington Faculty Club at 7:30 on Monday, August 5. See you there!

CALENDAR

San Diego Fern Society
Fern show and sale

Sale August 17 and 18
10:00 a.m. to 5:00 p.m.

Show August 17
12:30 p.m. to 5:00 p.m.
and August 18
10:00 a.m. to 5:00 p.m.

Casa del Prado,
Balboa Park, San Diego

Los Angeles International Fern Society
Fern and exotic plant show and sale

August 31 - September 2
9:00 a.m. to 4:30 p.m.

At the Arboretum of
Los Angeles County

Northwest Horticulture Society
Fall plant sale

September 27 and 28

Center for Urban Horticulture
Seattle, WA

Contents.....

PTERIDACEAE WORKSHOP University of California, Berkeley

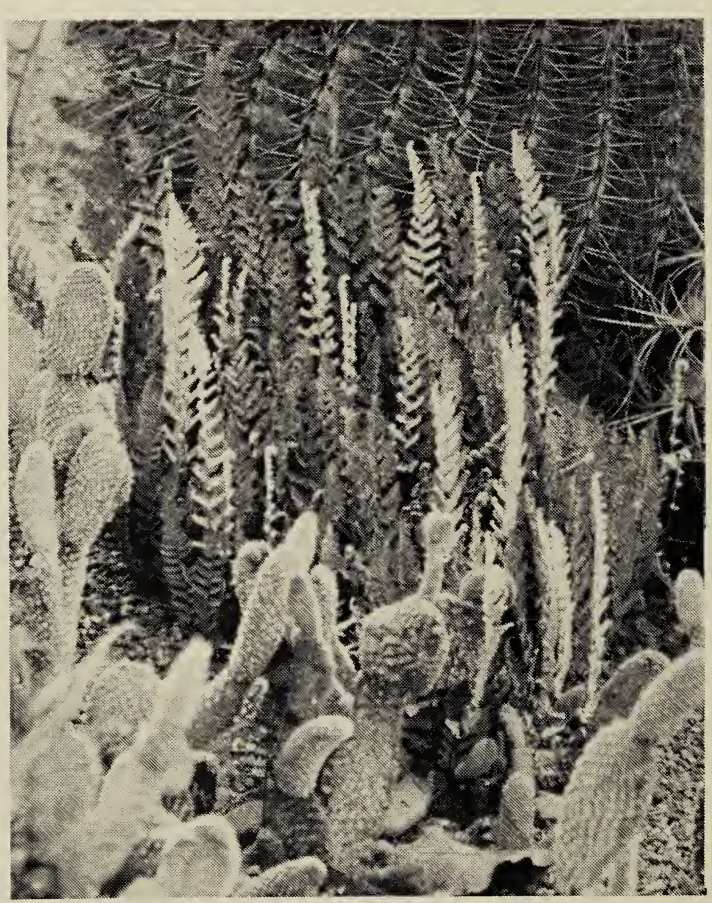
Wendy Born, Sebastopol, CA and Liz Parsons, Kenwood, CA

Since the publication of the Jepson Manual of Higher Plants of California (edited by James C. Hickman, University of California Press, 1993) the Friends of Jepson Herbarium have offered a series of weekend workshops to "demystify" the new genera and the name changing that accompanied the new, updated manual. In March 1996 Dr. Alan Smith, who contributed to the fern treatments in the Jepson Manual, taught a Pteridaceae workshop. Dr. Smith's time is usually spent in the herbarium or in the field and the workshop provided a unique opportunity to learn from Dr. Smith.

The workshops are geared to the layperson and participants at the Pteridaceae workshop ranged from graduate students to fern hobbyists, professional growers and the "truly knowledgeable". (*Hardy Fern Foundation members made up 50% of the class. Ed.*)

The workshop involved two days of intensive study and lab work using specimen plants and herbarium sheets. Microscopes were available for our use. The Pteridaceae family includes *Adiantum, Cheilanthes, Notholaena, Astrolepis, Argyrochosma,* and more. It did seem that the most sought after plants to be studied were the 'xerics'. At last, a chance to actually "see" an *Astrolepis* or *Argyrochosma* with Dr. Smith patiently pointing out some key characteristics of each genus. The participants were asked to write a simple key....which at first sounded impossible! However, this turned out to be a great learning experience (for example: serrate and seriate are two different terms) and one learned to keenly observe and describe characteristics.

L-R. Robin Halley, Barbara Hoshizaki & Frank Damgaard look on as David Schwartz & Alan Smith examine a fern at the Berkeley Botanical Garden. Photo by Harry Olsen.



Cheilanthes lindheimer at the Berkeley Botanical Garden. Photo by Harry Olsen.

The workshop was held in the new Robert Orndorff classroom which is located in the U.C. Berkeley Botanical Garden, where many of the ferns are in cultivation. Martin Grantham, grower and garden associate gave us a tour of the fern propagation area. and we also toured the garden. (*For an excellent and comprehensive description of the Berkeley Botanical Garden's fern collection see 'Ferning Around the World in 34 Acres' by Iris Gaddis in the Summer 1994 Hardy Fern Foundation Newsletter. Ed.*)

To be surrounded by fern enthusiasts and openly and unabashedly talk on and on about sori patterns, types of waxy exudates and scale characteristics was an exhilarating experience. Hopefully, the Friends of the Jepson Herbarium will continue to offer fern workshops. We'll be there!

(For more information about the Jepson Herbarium Workshops call Susan D'Alcamo (510) 643-7008.)

Perry Creek Appeal

18 June 1996

Mr. Dennis Bschor, Forest Supervisor
Mt. Baker-Snoqualmie NF
21905 64th Ave. West
Mountlake Terrace, WA 98043

Re: Perry Creek RNA

Dear Mr. Bschor:

Some years ago I proposed to the then Snoqualmie National Forest (Verlot Ranger District) that the undisturbed portions of the Perry Creek drainage (off the South Fork Stillaquamish River) be considered for Research Natural Area status.

I understand that the Establishment Report for Perry Creek has been written and that it awaits your endorsement and an Environmental Assessment. I write in support of moving the Perry Creek RNA to successful completion. It is timely now since Ms. Sarah Greene of the RNA Committee is making special efforts to get pending RNAs into the system.

This proposed RNA would protect one of the most unique fern diversity habitats in the Pacific Northwest - indeed, in all of Region 6. It has been visited by internationally known fern specialists, has been described in scientific literature (see enclosed reprint) and continues to attract botanists and members of the Washington Native Plant Society to study its unusual diversity.

Please consider this, then, a strong endorsement of achieving RNA status for the Perry Creek fern habitat.

Sincerely,
(signed)
A. R. Kruckeberg
Prof. Emeritus of Botany and
past president Washington Native Plant Society

The HFF board strongly supports the above proposal and we encourage members to write to the Forest Service in support of an RNA status for Perry Creek.

Hardy Fern Foundation 1996 Plant Distribution

The following plants are available to members. They are $5.00 each plus shipping and you will be billed at the time of shipping. Orders should be received by Sept. 1 and will be shipped in mid-Sept. Send your order to Steve Hootman, c/o The Rhododendron Species Botanical Garden, P.O. Box 3798, Federal Way, WA 98063-3798.

DRYOPTERIS CELSA - Log fern; native handsome fertile hybrid of *D. goldiana* and *D. ludoviciana*, 3-4', evergreen Zones 5 - 9.

DRYOPTERIS CHAMPIONII - Champion's wood fern, shiny Japanese evergreen, 2-3', Zones 5 - 9.

DRYOPTERIS CRASSIRHIZOMA - bold Japanese evergreen covered in new growth with ornamental shaggy scales, 2-3', Zones 5 - 9.

DRYOPTERIS FILIX-MAS 'BARNESII' - Very narrow and erect sub-evergreen to deciduous foliage with toothy margins, British cultivar, 3-4', Zones 4? 5 - 9.

DRYOPTERIS SACROSANCTA - New Japanese introduction, frosty young foliage, 2'+, reported last year as Zones 7 - 9 but appears to be much hardier.

DRYOPTERIS SUBLACERA - robust evergreen, dark green to 2', substantial foliage that combines well with delicate foliage, Zones 6?, 7 - 9.

PHYLLITIS SCOLOPENDRIUM - Hart's tongue fern; simple (undivided) fronds to 18", likes lime, evergreen, Zones 5 - 10

POLYSTICHUM POLYBLEPHARUM - Tassel fern, shiny evergreen from Japan, outstanding in the garden or as a house plant, 18", Zones 6 - 10.

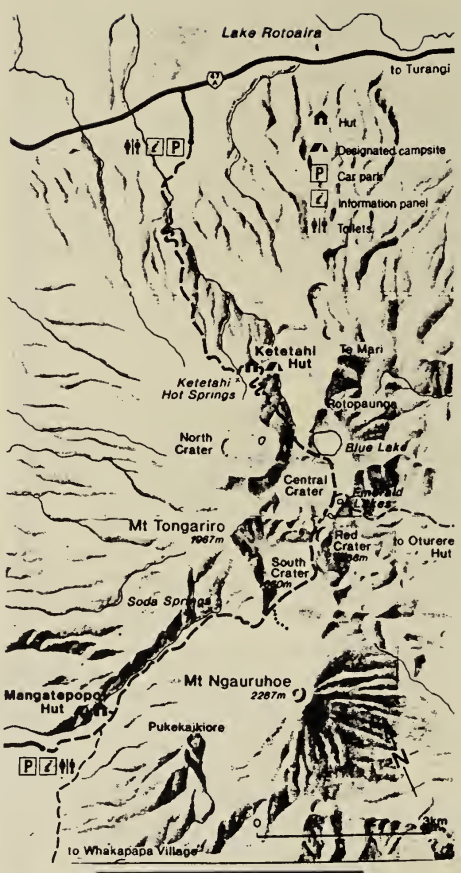
POLYSTICHUM TSUS-SIMENSE - Korean rock fern, small 12-18" evergreen with dark central markings, excellent in flower arrangements, Zones 6 - 10.

The Tongariro Crossing

Joan Eiger Gottlieb - Pittsburgh, PA

A summer month in New Zealand (Dec. 27,1995 - Jan. 23,1996) was full of memorable experiences, including a helicopter lift onto the pond-pocked scrub of the Borland Saddle, a white-knuckle, 4-wheel drive safari over the "top-of-the-world" Old Man Range, an overnight voyage on Milford Fiord surrounded by vertical rock walls and hanging glacial valleys and, on our last day, the serendipitous find of a rare, primitive psilophyte - *Tmesipteris tannensis* - in a private garden near Dunedin. And that's just a small sampling of our adventures on a tour of the South Island following the Southern Alpines '96 Conference in Christchurch. Stay tuned for details in a future article.

But, if forced to choose the most unforgettable and exhilerating adventure of all, it would, without hesita-tion, be the North Island's **Tongariro Crossing (T.C.)** which we did on a pre-conference tour of our own. The T.C. is a 9.3 mile (15 km) tramp ("kiwi" for hike) that rises from the lava-layered western end of Tongariro National Park to a moonscape saddle of volcanic craters between Tongariro (6437'; 1968m) and Ngauruhoe (7493'; 2291m) Mountains and then makes a right angle turn to the north through tussock scrub, manuka bush and lowland forest. It is deservedly described as "the world's finest one -day walk." Tongariro National Park, New Zealand's first (4th in the world,) was created in 1887 with an initial gift of Maori tribal land. Subsequent acquisitions now make it one of the largest national parks in the world, encompassing 188,000 acres (76,000 hectares) in the center of New Zealand's North Island, just below Lake Taupo. Mt. Ruapehu (9149'; 2797m) at the south end is the park's tallest, although its spectacular eruption on October 7, 1995 scaled back its lofty summit somewhat. It was still sputtering sporadically when we were there the last day of December and all three of the major mountains in the park are active volcanoes.



The Tongariro Crossing

To do the Tongariro Crossing you must arrange to be dropped off and picked up since it is a one-way track (trail.) Major New Zealand towns have excellent Visitors' Centers and the one in Turangi, a few kilometers northeast of the park, has relevant trail maps and an expert staff to arrange trailhead transport. Or, stay inside the park at the elegant Chateau Hotel or the more modest Skotel (Skiers Motel) at Whakapapa Village (love those Maori names!) The Village has an Information and Arrangements Center.

Our friendly van driver dropped us off at the end of the Mangatepopo Road at 8:30 A.M. and we thought we detected a skeptical look as he pointed to the trail and then glanced back at us. The Mangatepopo Hut lay directly before us - one of a series of large, well-maintained shelters serving New Zealand's track users. The crossing should be attempted only by the physically fit and only on a day that promises clear weather. There are NO amenities between huts (6.25 miles; 10 km) so lots of water and nutritious foods are a must. We tightened the laces on our Nikes and checked our "gear." Sunhat, sunscreen, sunglasses and long cotton pants and shirts for this high altitude, ozone-hole proximate area! A day pack stuffed with extra layers of clothing and rain gear! All set, we started across a flat, harsh landscape of volcanic debris where tough, alpine scab and cushion plants (*Raoulia, Donatia, Epilobium* et al.) provided occasional, colorful relief to the straw-pale grasses and charcoal gray ground. Lichens and dark mosses were colonizing the pumice-textured boulders and the whole scene had a surreal, Star Trek feeling. The trail, marked with evenly-spaced poles, soon reached the foot of Mt. Ngauruhoe, the source of the relatively new lava, rocks and ash strewn over the area we had just traversed. Youngest of the park's peaks, Ngauruhoe had its irregular summit reshaped in a series of violent eruptions in the 1950's.

Here began the steady climb to Soda Springs, a pleasant mountain stream and waterfall. *Giardia* and other nasty parasites are now common in New Zealand water, so no surface source is safe to drink, no matter how clean and tempting it looks. The moist rocks along this section of the trail shelter *Parahebe lyallii* (with its candy-cane striped flowers,) *Ranunculus insignis* (the glossy-yellow, Lobe-Leaf Buttercup) and perky, white-flowered *Ourisia macrocarpa* (one of New Zealand's appealing Scrophs.) In a drier area above the falls there was *Gaultheria antipoda* (a heath,) *Anistome aromatica* (Mountain Carrot) and *Brachyglottis bidwillii*, a beautiful, succulent-leaved Compositae shrub. The ground-hugging *Podocarpus nivalis* was shedding pale gold-colored "dust" from its abundant pollen cones, blanketing the seed cone plants splayed out nearby - very reminiscent of Northern Hemisphere arctic willows.

Mountain daisy
Celmisia sp.

It was time to concentrate on our footing; the volcanic ash was getting deeper as the trail grew steeper. Slipping a half step back for each couple of steps up, it was 45 minutes of slow and exhausting plodding to the saddle area of South Crater. We paused at its crest to eat our lunch, watch restless clouds alternately hide and expose the conical crown of Ngauruhoe on our right and catch panoramic glimpses of western New Zealand on our left. On really clear days it is reportedly possible to see Mt. Taranaki (Mt. Egmont) on the Tasman coast.

Our watches read 11:30 A.M. and a well-placed sign warned that it was still 3 1/2 hours to Ketetahi Hut. Reluctantly, we left our lofty perch to push onward and downward directly into the bowels of South Crater, a barren expanse of ancient volcanism. Except for a lack of spacesuit garb we could have easily convinced ourselves that we had stepped onto the moon. The flanks of Mts. Tongariro and Ngauruhoe rising on our sides gave a starkly isolated feeling to our walk across the crater floor with its cracked patches of black magma burping puffs of sulfurous smoke. A constant, but well-spaced trickle of hikers joined us as we started up and out the far end of the bowl. Suddenly our eyes were drawn to the ocher-hued, steaming walls of Red Crater, an active magma region where molten rock extrusions harden like ornamental pottery - artful dikes from "Mother Earth."

Finally, we turned our eyes and camera lenses away from these mesmerizing rocks and toward their next reward - the brillliant green of three Emerald Lakes at the edge of the Central Crater, just below our unsteady feet (we were once more sinking into unstable slopes of loose ash.) Sliding more than walking, we descended to these remarkable watery jewels - their color attributable to "mineral flour" - a fine silt leached from adjoining thermal areas. Deceptively calm and beckoning, these water-filled explosion craters are hot and quite corrosive. From the trail we got several eye-catching views of the Rangipo - New Zealand's only desert, on the dry, eastern flanks of the mountains.

Crossing Central Crater and glimpsing North Crater's hanging ice shelves on our left, we soon saw the circular outline of Blue Lake in the deepest part of the bowl. It is, in fact, an old volcanic vent. From this point the descent from the crater field was via a long series of switchbacks meandering through tussock-grass scrub to Ketetahi Hut. It was reassuring to see plants reappear after the lifelessness of the craters. The endemic Mountain Daisies (*Celmisia spp.*,) with their large, white Composite blooms were particularly welcoming. And, along sheltered seeps, *Polystichum vestitutm, Sticherus cunninghamii* and *Lycopodium scariosum* represented the pteridophyte flora. The hut, with its spotless toilets was another welcome sight and resident research and maintenance staffers answered our many questions most patiently. Rainwater collected off the roof of the hut is supposedly safe to drink.

Tmesipteris tannensis

A side trail to Ketetahi Springs was well-worth the short detour, for this is an active, exciting thermal field occurring in a mountain gash. The whole hill appears to be belching smoke and brimstone and the acrid, sulfur odor can be quite overwhelming downwind - all part of the ambiance, we said. Trekkers can shed shoes and socks to soak tired feet in the somewhat cooled water downstream; but, with 2 1/2 hours still to go, rest was not on our schedule.

Picking up the main trail once more, we plunged back into tussock scrub and then a stretch of dense manuka (*Leptospermum scoparium*) bush before reaching the cool shade of mixed forest along a branch of the Mangatipua Stream. This was the most beautiful lowland rain forest we saw on the North Island, with towering podocarp (*Podocarpus totara* et al.) and southern beech (*Nothofagus menziesii* and *N. solandri*) trees, their layered branches draped with epiphytic lichens, mosses, orchids, *Asplenium, Grammitis, Hymenophyllum* and more. An understory of vines and evergreen, smaller trees, including lots of tree ferns (New Zealand has only 6 species of deciduous woody plants,) formed a varied sub-canopy. And, best of all, the forest floor was almost solidly carpeted

Trichomanes reniforme

continued on page 39

Cheilanthoids

Robin Halley, Newsletter Editor & Webmaster - San Diego Fern Society

What are cheilanthoids ? When I started studying dry-land ferns I kept reading the term and hearing people talk about it, but it was never clear what cheilanthoids were and why they were called that.

Introduction

I started asking the experts and found that even they found this a difficult question. No one has a formal definition of cheilanthoid. The closest I get is an explanation in the introduction to the Pteridaceae in the *Flora of North America*, Volume 2, Pteridophytes and Gymnosperms (1993, p. 122), where Michael Windham explains that the Pteridaceae have evolved into three major evolutionary lines (the adiantoids, the pteroids, and the cheilanthoids).

The general category of cheilanthoids mostly includes ferns that grow in exposed or dry places. Thus, the cheilanthoids are often also referred to as xerophytes. That Greek word *xerophyte* breaks down to *xeros*, which means dry, and *phyton*, which means plant. Not surprisingly, in North America the genera usually described as belonging to this loosely-defined group belong mostly to the tribe Cheilanthes and include: *Argyrochosma*, *Aspidotis*, *Astrolepis*, *Bommeria*, *Cheilanthes*, *Doryopteris*, *Hemionitis*, *Mildella*, *Notholaena*, *Pellaea*, *Pentagramma*, and *Trachypteris*.

Taxonomically there has been much confusion about this group. Recently, the major area of contention seems to have been between *Cheilanthes*, *Notholaena*, and *Pellaea*. As the fern knowledge base has changed, some ferns have been placed in one group and then another. *Argyrochosma limitanea* has been *Notholaena*, *Pellaea*, and *Cheilanthes*. *Cheilanthes bonariensis* was placed into *Notholaena* in the 1950s and then back to *Cheilanthes* in the 1980s. The genus *Aspidotis* was recognized as a different genus in the late 1960s , fell out of use in the 1980s, and is revitalized as a separate genus in the recent *Flora of North America* (Volume 2, p. 170).

The cheilanthoid taxonomy was further clarified by the work of George Yatskievych, David Benham, Michael Windham, and others. They brought the more recently-developed chemical and microscopic procedures to bear on the problem. As a result of this research, the genera of *Argyrochosma* and *Astrolepis* were separated from *Pellaea*, *Cheilanthes*, and *Notholaena*; and the genus *Pentagramma* was differentiated from *Pityrogramma*.

This article discusses the adaptations and habitats of the xerophytic cheilanthoids. That discussion is followed by a more specific discussion of the North American genera assigned to this group and then by cultivation suggestions.

Adaptations

The cheilanthoid ferns have developed a large set of adaptations which enable them to grow in dry places. None of the plants has all the adaptations, but most have several.

- These plants are characterized by thickened, leathery epidermis. This protects them from drying out. Plants which show this characteristic include *Astrolepis sinuata* and *Cheilanthes newberryi*.
- They generally also have hairs, scales, and/or a wax-like substance on the fronds, stipes, and rhizomes. The hairs and scales control the local humidity by producing still-air zones near the plant. These work much like the robes worn by Arabs in the desert to keep the transpired water near the plant rather than allowing it to immediately evaporate. Ferns that are good examples of this characteristic include *Cheilanthes covillei* and *C. parryi*. The wax-like substances may work to reflect sunlight and keep the plant's temperature down. This is still conjecture as most of the wax-like substance is usually found on the underside of the fronds. Good examples of this are *Notholaena californica* and *Pentagramma triangularis*.
- Some cheilanthoids have developed finely dissected or narrow pinnules. This reduction in the leaf surface may reduce water loss. Examples are most of the Pellaeas, *Aspidotis densa*, and *Cheilanthes viscida*.
- Most of the cheilanthoid ferns develop unusually long roots. This allows them to go deep for water, but even more it allows them to send their roots far under rocks where it is cooler and often moister.
- Cheilanthoids generally show rapid growth and early sexual maturity. Some species develop viable spore as early as two months after germination. The rapid growth enables cheilanthoids to take advantage of what can be a very short rainy season. For example, for the many species which live in the deserts, such as *Cheilanthes covillei* or *Pellaea ternifolia*, the entire rainy season may only last a few weeks.
- Cheilanthoid spores remain viable over long dry periods. Viable spores were taken from one herbarium specimen after more than two years. Spores kept in an anhydrous sodium chloride environment for 16 months were still viable.
- Cheilanthoids tend to curl out rather than in. This means that the spore-bearing surface is more exposed, facilitating wind-borne scattering of the spore.
- Cheilanthoids respond to dry conditions by first increasing transpiration (raising humidity, especially in conjunction with the abundance of hairs) and then, as the dry conditions persist, reduce transpiration to marshal their water reserves.
- As an additional aspect of their controlled dehydration, cheilanthoids can dry up without injuring the cell tissues and then with a well-timed sup-

ply of water can partially or completely recover. As a test of this, find a dried-up cheilanthoid frond and soak it in water overnight. The frond will often completely uncurl. There is also a suggestion that these plants also have a non-drying substance in the cells which aids in reducing dehydration.

- One of the most important adaptations is cheilanthoids' ability to reproduce asexually. This ability is called *apogamy*, and the importance is that it enables sporophytes to develop in the absence of water required during sexual reproduction enabling the sperm to "swim" to the ova. Here is a brief description of how apogamy works:

  1. During the fourth division in mitosis (when the chromosomes usually split), the chromosomes in the cells do not split, so the cells end up with four sets of chromosomes (tetraploid) instead of two.
  2. At meiosis, when the cell chromosomes normally unpair, the cells split but end up with two set of chromosomes (diploid) instead of one (monoploid).
  3. Prothallia developing from the unreduced cells can develop sporelings which are identical to the parent without fertilization. To further complicate things, these prothallia can develop viable spore which can fertilize eggs on normal prothallia. This results in plants with triploid chromosomes and, continuing the sequence, even higher ploidy counts (e.g., tetraploid).

Cheilanthoids also take advantage of a less-understood form of asexual reproduction called *apospory*, where new plants arise from prothallia which develop on the fronds.

Habitat

Most of these fern live close to rocks. Indeed, a large number of the species typically live pressed (*appressed*) right up against the rocks. There are several advantages to this growth habit.

The first, obvious advantage is shade. The rock will shade the plant during some part of the day. Less obvious is that since the rock changes temperature slowly during the day, the temperature close to the rock will also change temperature more slowly than away from the rock. This means that plants close to the rock suffer less stress from rapid temperature changes. Other advantages are:

- cheilanthoid roots (remember, they tend to grow long roots) can grow way under the rocks where they will remain relatively cool
- the rock channels dew and rain to the ground near the rock to provide a relatively moist (*mesic*) area

The cheilanthoids which do not live close to rocks typically grow in natural drainage or seepage. One often finds these plants growing on steep hillsides where the draining water stays close to the surface.

The North American Cheilanthoid Genera

This section covers most of the cheilanthoid genera found in North America. It conforms to the definitions provided in the *Flora of North America*.

Cheilanthes (Lip Fern)

There are about 125 species of *Cheilanthes* worldwide. These are mostly found in arid places from the United States to Peru. The plants are small- to medium-sized with the stem (stipe) about equal in length to the blade (lamina). Most species have curly hairs and/or scales on the back (abaxial) side of the laminae. A few species have only hairs.

All fronds are fertile (monomorphic). *Cheilanthes* typically have a false indusium with the sporangia following the margin of the leaf segment (pinnule). Those species without the false indusium have three-pinnate laminae with very small bead-like segments (e.g. *Cheilanthes covillei*). These plants have a base chromosome count of 30 pairs (x=30, except x=29 in the *Cheilanthes alabamensis* complex).

Notholaena (Cloak Fern)

This genus includes about 75 species, found only in the western hemisphere from the western U.S. to Central and South America. The typical plant habitat is arid and rocky.

The plants are called cloak ferns because the blade margin is not turned back (reflexed). Some resemble *Cheilanthes* and some resemble *Pellaea*. Many have been recently placed into *Astrolepis* or *Cheilanthes*. The species native to the U.S. are less divided. The plants are typically small, monomorphic, and have stipes as long or longer than the most highly-divided laminae. These plants have a base chromosome count of 30 pairs (x=30).

Some species have a white, cream, or yellow wax-like covering (farinose exudate) and sometimes also hairs or scales on the abaxial surface of the laminae. Other species have only hairs and/or scales or neither hairs nor scales (glabrous) on the abaxial surface. The *Notholaena* commonly fold their segments upward to expose the protective and reflective farinose covering on the abaxial surface.

Astrolepis (Star-Scaled Cloak Fern)

The members of this genus were previously known as the *Notholaena sinuata* complex. Now they are recognized as a complex of hybrids with many triploid and tetraploid members of the complex. Three species were originally known (*A. sinuata*, *A. integerrima*, and *A. cochisensis*), but others are being identified and named (*A. beitelii* and *A. windhamii*). Michael Windham predicts

Cheilanthoides continued on page 36

that, given further research, many other species may be found.

Most of the characteristics of *Notholaena* apply. However, all *Astrolepis* are once pinnate and the sporangia follow the veins rather than the edge of the frond. The *Astrolepis* have a base chromosome count of 29 pairs (x=29), as opposed to the Notholaena with 30 pairs (x=30).

Pellaea (Cliff-Brake Fern)

There are about 80 *Pellaea* species, with a worldwide distribution. Their habitat is also arid tropical to sub-tropical regions. Some look like miniature *Pteris* (Brake Fern) and tend to grow on cliffs, which accounts for the name Cliff-Brake Fern.

The *Pellaea* are distinguished from *Notholaena* because the lateral halves of the pinnae, pinnules, or segments fold down rather than up. The segments are ovate to elliptic, and never beadlike as in *Cheilanthes*. The *Pellaea* are usually monomorphic, small- to medium-sized with short-creeping or many-headed (multicipital) rhizomes bearing tufts of fronds. The sporangia grow along the margin. There is no indusium, but the sporangia are protected by the underrolled edge (lateral margin) of the pinnae, pinnules, or segments on which they are borne. The Pellaea have a base chromosome count of 29 pairs (x=29).

Argyrochosma

These plants mostly look like *Pellaea*, and the classification has been kicked back and forth between *Pellaea*, *Notholaena*, and *Cheilanthes*. Recent research shows that the *Argyrochosma* have a base chromosome count of 27 pairs (x=27) which is different from the typical x=29 or x=30 for other cheilanthoids.

The distinguishing characteristics for *Argyrochosma* are a combination of single-colored (concolorous) scales and blade segments less than 4 cm. They are also characterized by white farinose indument on the the abaxial surface of the fronds.

Aspidotis (Lace Fern)

These plants are small and short-creeping. The leaves are monomorphic to somewhat dimorphic. The leaf blade is ovate-triangular, deltate, or triangular; 3-4 times pinnate; without hairs (glabrous) adaxially, lustrous abaxially. Three species are recognized in North America: *Aspidotis californica*, *A. densa*, and the fertile hybrid of *A. californica* and *A. densa*, *A. carlotta-halliae.* The base chromosome count is x=30.

The range is restricted to the western U.S. Habit is terrestrial, often at the bases of boulders or in rock crevices, in dry to moist, montane areas, woodlands, or chaparral.

Bommeria

These plants are small, prostrate, and long-creeping. The leaves are monomorphic and scattered along the creeping rhizome. The blade is pentagonal and is divided into three segments, deeply pinnate-pinnatifid. The leaves have scales on the lower surface (abaxially). There are no false indusia, and the sporangia follow the veins. The only species occurring north of Mexico is *Bommeria hispida*. The base chromosome count is x=30.

The habitat is the base of large boulders on dry to moist slopes, primarily in mountainous, xeric regions (1000-2500 meters); occasionally forming large mats.

Pentagramma (Silverback Fern, Goldback Fern)

These plants were classified as *Pityrogramma* until the recent work by Michael Windham and David Benham. The major bases for the reclassification were:

- *Pityrogramma* has flanged spores and a base chromosome count of x=29
- *Pentagramma* has cheilanthoid spores (no flange) and a base chromosome count of x=30

Based on this work, *Pentagramma* are characterized as small- to medium-sized. They have dark wiry stipes, and the laminae are pinnately organized or pentagonal. The laminae have no false indusium. The spore are spread over the abaxial surface and are not confined to or near the margin. The fronds are not hirsute or scaly.

The laminae are usually covered with a white or yellow exudate, especially on the abaxial surface. Although referred to as waxy, the exudate is neither wax nor farina.

These plants grow almost exclusively in the United States, especially California. Currently there are two recognized species, *Pentagramma pallida* and *Pentagramma triangularis*. *Pentagramma triangularis* is further divided into the sub-species *P. t.* subsp. triangularis, *P. t.* subsp. maxonii, *P. t.* subsp. semipallida, and *P. t.* subsp. viscosa. However, according to experts on the Pteridaceae, there is still much more study to be done to sort out the relationships in this genus. Recent work suggests that some or all of the subspecies could be raised to species classification.

Cultivation Suggestions

First, it is important to note that most of these plants are not easy to grow. Many of them come from areas where they spend up to half the year dormant, waiting for the rains. The two best growers I know, David Schwartz and Clive Brotherton, both stress drainage, drainage, drainage.

Before you worry about soil, research the plant. If it comes from the U.S. west coast, it's going to get its natural water supply in the winter, with very little during the summer. If it comes from Arizona, New Mexico and Utah, there is a summer monsoon season to augment the winter rains. If it comes from the U.S. south, summer can bring torrential rains. Try to determine the natural soil content. Some plants grow on limestone (calcium), and some never grow on limestone. The more you know, the better are your chances of success.

Cheilanthoids in the author's garden. Photo by Robin Halley.

Soil

Both Schwartz and Brotherton grow most of their plants in pots. Schwartz sometimes uses a mix of about 1/2 construction sand (bigger than cement sand) and 1/2 normal potting mix. He also often uses gravel in his mix. No one knows for sure what Brotherton uses, but it is very loose. I, too, usually add gravel to my mixes. However, I am currently experimenting with volcanic rock (1/2 rock, 1/4 peat, 1/4 redwood compost).

If you collect a plant from the wild, bring back some of the soil. There are two reasons. First, you can use the soil as a growing medium. Second, you can study it and try to duplicate the content for your plants.

Light

Most of these plants can take nearly full sun, but you should protect the roots. If planted in the ground, plant next to a large rock. If planted in pots, shade the pots. Sometimes you can accomplish this just by grouping the plants.

Water

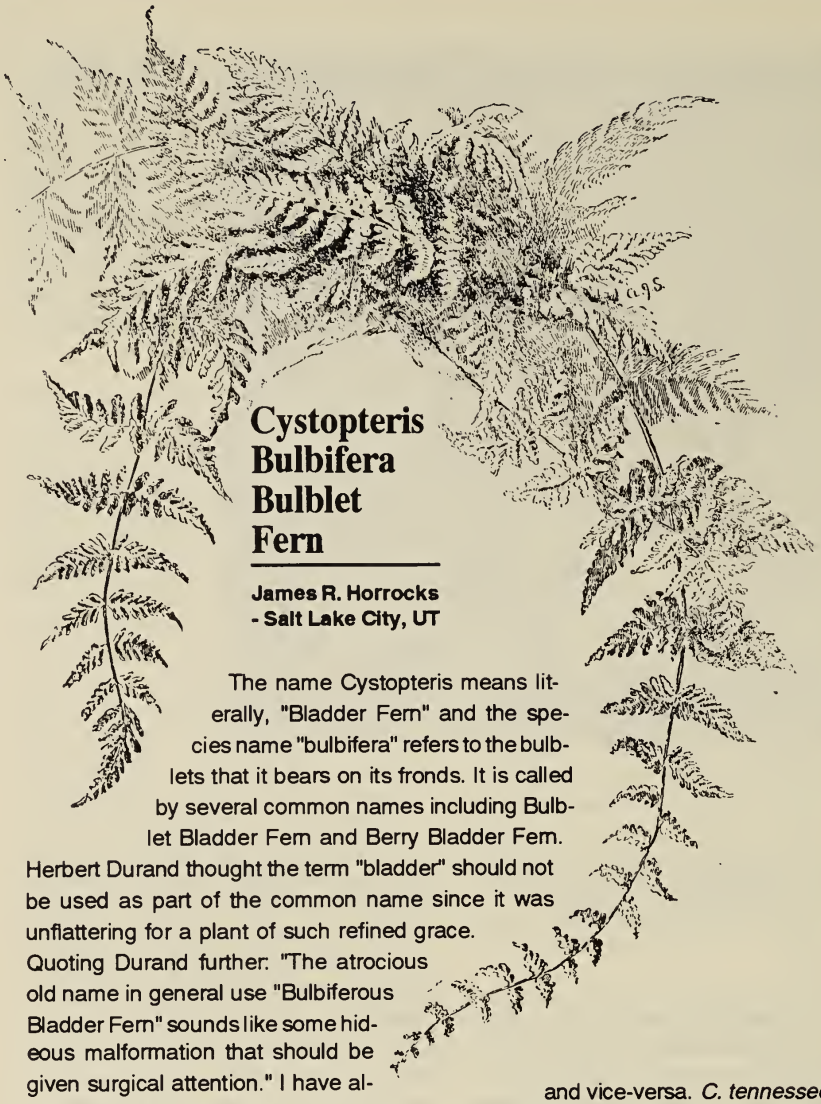
Be very careful not to overwater. Most of these plants are not used to continuously wet conditions and are susceptible to rot. Remember, in nature, many of these plants go dormant when the humidity drops (no matter how much they are watered). If you have plants in containers, you may be able to extend the growing season by keeping the humidity up.

Some people water from the bottom, as most of the time these plants would collect water from their roots. In any case, avoid constant water on the foliage, especially with the lacier fronds. I use a drip system for the plants in the yard to provide water directly to the roots.

Fertilizer

There is some disagreement about this. One camp suggests very limited fertilizer, because the plants normally come from deprived soils and you don't want to over fertilize. Another camp recommends a normal dose of fertilizer (1/2 recommended dosage as for any fern) because the cheilanthoids want food just like any plant. My recommendation is to be conservative with fertilizer. If you want to experiment, start with 1/4 the recommended application and work slowly up to 1/2, watching carefully for signs of too much fertilizer.

The cheilanthoids are very interesting AND they grow in the sun. Good luck. If you have questions regarding information in this article and have e-mail access, send your questions to sdfern@inetworld.net. If you don't have e-mail, send questions to Robin Halley, 1418 Park Row, La Jolla CA 92037-3710 USA.



Cystopteris Bulbifera Bulblet Fern

James R. Horrocks
- Salt Lake City, UT

The name Cystopteris means literally, "Bladder Fern" and the species name "bulbifera" refers to the bulblets that it bears on its fronds. It is called by several common names including Bulblet Bladder Fern and Berry Bladder Fern. Herbert Durand thought the term "bladder" should not be used as part of the common name since it was unflattering for a plant of such refined grace. Quoting Durand further: "The atrocious old name in general use "Bulbiferous Bladder Fern" sounds like some hideous malformation that should be given surgical attention." I have always called it simply the Bulblet Fern.

This species ranges from Newfoundland to Ontario and Minnesota westward to eastern South Dakota and eastern Nebraska and southward to Oklahoma, Missouri and eastward to Alabama and North Carolina. It is disjunct in western Texas, New Mexico, Arizona, and Utah. Hence, it is for the most part native to eastern North America, being locally abundant or strangely absent in many locales.

It's long tapering fragile fronds are not likely to be confused with other species in the field, but in the garden it could be mistaken for *Cystopteris tennesseensis* and vice-versa. *C. tennesseensis*, however, has pinnae that are more broadly triangular, giving the fronds a much fuller, leafier aspect. It also produces fewer bulbets than *C. bulbifera*.

Description: The rhizome is short-creeping with quite congested stipe bases which are usually dark brown or blackish, with few lanceolate scales. The stipe is about one-half to one-third the length of the blade, dark reddish-brown at the base, very often of a purplish color above with sparse scales. The light green to medium green blade is linear-lanceolate to long triangular-lanceolate in outline, bipannate-pinnatifid almost its entire length. The fronds are from one to three or even four feet long and are widest at the base, tapering gradually to a long slender tip. The base can be three to five inches wide. The pinnae are deltoid lanceolate to oblong lanceolate with pinnules that are oblong, broadly decurrent, and pinnatifid or deeply incised.

Although firmer in texture than *C. fragilis*, the fronds are still easily broken if not protected. Most interesting are the ovoid or lobed bulblets that form on the underside of the fronds along the rachis and pinnae midribs. About the size of a sweet-pea seed, the bulblets detach and take root rather quickly. They can be gathered and planted, usually several together, to produce mature plants in about two growing seasons.

The sori are small and roundish in a double row on each pinnule. One sori appears near the base of each segment of the pinnules. The indusium is dome-shaped and covers the sporangia in the form of a tiny pocket or bladder, hence the genus name. The indusium fragments soon after the spores are ripe.

C. bulbifera hybridizes with *C. fragilis* to form *C. laurentiana*, similar in outline to *C. fragilis* but with fewer smaller bulblets. *C. bulbifera* also hybridizes with *C. protusa* to form the robust *C. tennesseensis*, already mentioned. Both hybrids are fertile. One variety of *C. bulbifera* is known, var. crispa, with smaller fronds and wavy margins, discovered in the wild in Falls Village, Connecticut.

Culture: The Bulblet Fern is quite easily grown. Although often associated with limestone, it does not necessarily need this medium nor does it demand wet conditions to flourish. In semi-arid climates such as here in northern Utah, it has done quite well in gardens with only average soil, as long as the soil does not completely dry out. It is, of course, at its best when given ample moisture and

grown in a shady place. It is quite striking grown in large colonies and in the author's garden there is in its midst the occasional *Cyrtomium fortunei* var. clivicola, the contrast being quite interesting: the boldness of "clivicola" with the daintiness of bulbifera. As has been mentioned, the curious little bulblets can be harvested and planted in nooks and crannies for wonderful effect in a very short time. The Bulblet Fern is a very worthy addition for the shaded garden although I must add a word of caution: because of the bulblets, it can get out of hand and seriously compete with other small ferns.

References:

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

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

Ferns to Know and Grow, (Revised Ed. 1984) F. Gordon Foster, Timber Press, Inc., Portland.

Field Book of Common Ferns, (Revised Ed. 1949) Herbert Durand, G.P. Putnam's Sons, New York.

Hardy Fern Foundation

The Hardy Fern Foundation Newsletter is published quarterly by the Hardy Fern Foundation, P.O. Box 166, Medina, WA 98039-0166.

Articles, photos, fern and gardening questions, letters to the editor, and other contributions are welcomed!

Please send your submissions to Sue Olsen, 2003 128th Ave SE, Bellevue, WA, 98005.

Newsletter:

Editor: *Sue Olsen*
Assistants: *Janet Dalby, Sylvia Duryee, Sue & Herman Entz*
Graphics: *Karie Hess*

Bulblet Bladder Fern

portion of fruiting pinna

The Tongariro Crossing
continued from page 33

with ferns, including the regal, rosette species of *Blechnum* (*B. fluviatile* and *B. discolor.*)

But the prize find of the day was a gossamer stand of *Trichomanes reniforme* festooning moist tree bases and logs near the water. The translucent, kidney-shaped fronds of this choice filmy fern were over two inches (6 cm) wide, with an edging of sunken sori that was truly picture-perfect. Add to all this the ringing call of a bellbird and the distinctive trill of white-throated tuis and we were truly in an enchanted forest.

From here we literally ran the rest of the way to the road - arriving 40 minutes late for our 5:30 P.M. pickup. The driver was quite relieved to see us and we didn't even get the tongue-lashing we expected for our tardiness. Our intuition at the morning drop-off was prophetic; he had sized us up as marginally fit types who would have trouble finishing the trek in the average time of 8 hours (if at all!) We could have pleaded our truthful time-expansive needs for botanizing and photographing. But, completely exhausted, we simply sank into our seats and surrendered to the rush of a true mountain "high" - and one of the best days of our lives!

ARACHNIODES STANDISHII Continued

IT'S A .....FROND! In reference to the article on *Arachniodes standishii* in the Spring 1996 HFF Newsletter, your editor is happy to report that on the morning of May 17, 1996 two little fronds appeared in the *standishii* culture. On July 5, over two hundred little plantlets were separated and potted on. Some of these will one day make their way to our test and display gardens - all as a result of the light treatment!

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