

Ferns of Hendricks Park

Martin Sage

Cover photo: *Polystichum munitum*, January 2012. The western sword fern provides extensive ground cover in the forested part of Hendricks Park.

THE FERNS OF
HENDRICKS PARK
EUGENE, OREGON

An annotated checklist compiled
and photographed by
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The Ferns of Hendricks Park

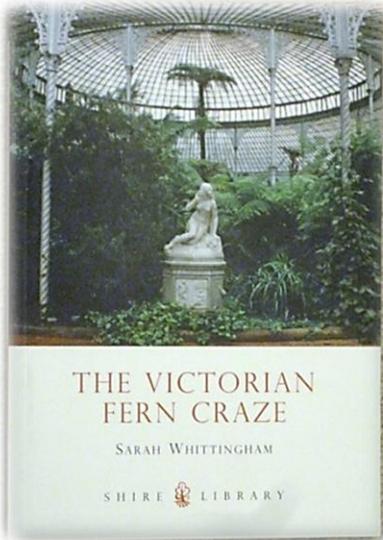
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Prologue: A personal note

Although I taught biology in universities for more than 42 years, I have no professional knowledge of either taxonomy or ferns. Hence this work is little better than that of an enthusiastic amateur, with the corresponding high probability that I have made mistakes. I do not have access to laboratory facilities that would allow me to determine chromosome numbers or analyze DNA. These limitations indicate that this checklist is intended mainly for the visitor to Hendricks Park and perhaps gardeners or students interested in plants. Accordingly, there is no list of academic references or documentation as to who originally described a species.

Casual visitors to the park probably need only a photograph and description of a fern with a name that enables them to place an order with a local plant nursery or discuss the plant with a friend. I have also given the locations of the commoner ferns but have tried not to give away the locations of the rarer specimens.

I hope that my commentary may stimulate further interest in a group of plants that flourished millions of years ago when coal deposits were forming—a fact that impressed me as a child when I watched fossil ferns and their relatives burning in our fireplace at home.

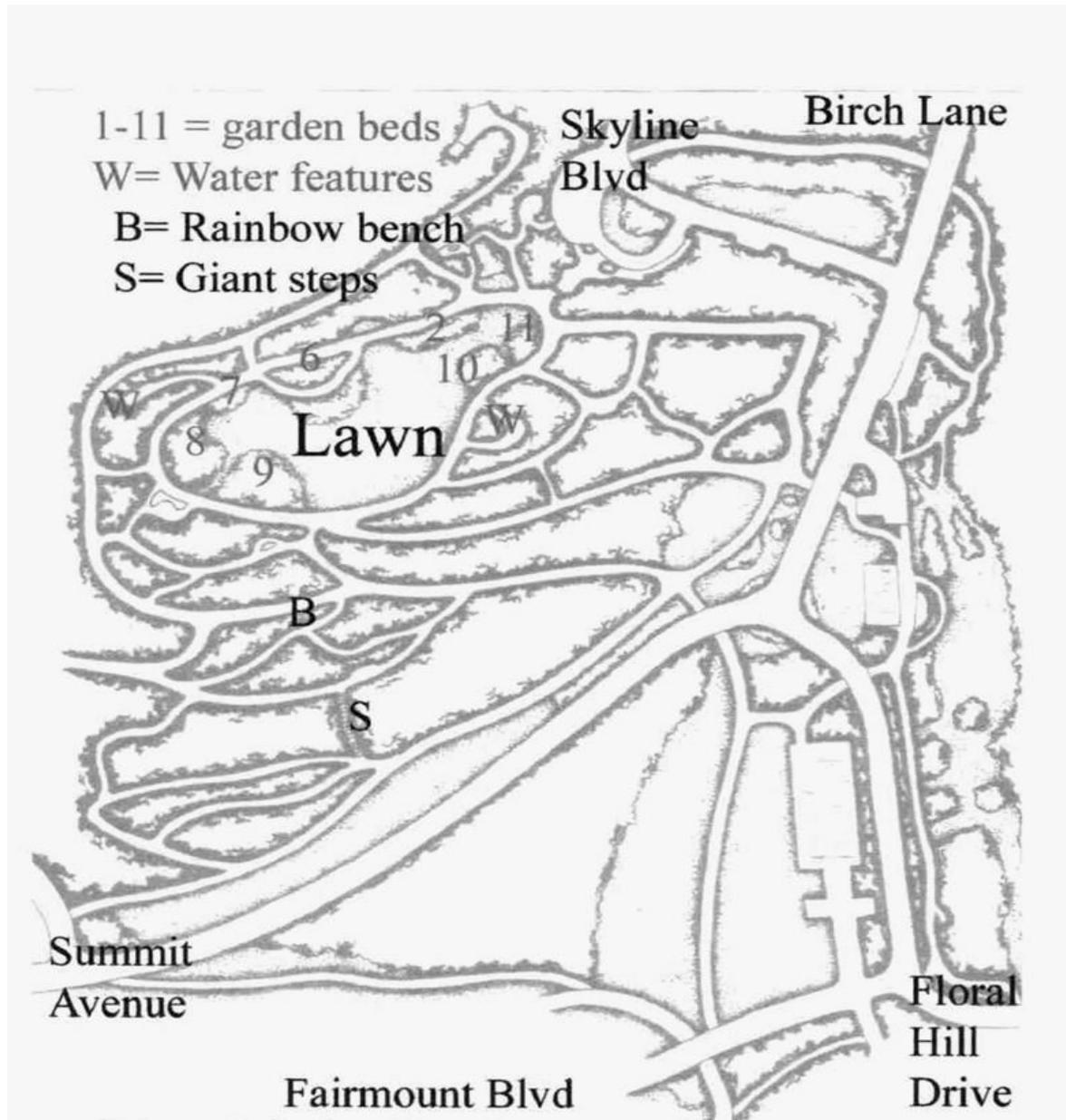


I started this project when a local gardener told me that a fern in Hendricks Park was an Alaskan fern (with the implication that it probably came from Alaska). I knew from my English childhood that the fern was of European origin and was one of a number of cultivars discovered in the United Kingdom perhaps a hundred years earlier. During Victorian times, England was the home of pteridomania, or fern madness, which afflicted my countrymen in the nineteenth century. So perhaps carrying in my genes the spores of pteridomania, I set out to produce a checklist of the park's ferns with a commentary that might dispel some misconceptions while not introducing too many of my own.

Hendricks Park: Maps

Main areas of the park and some neighboring streets. The Rhododendron Garden is to the north, and the Native Plant Garden to the northeast. The rest is forest, mostly dominated by Douglas-fir, with some Oregon white oak and maples. The small Oak Knoll in the western part of the forest is a relic of the oak savannah that covered the park when the land was first purchased in 1906. It contains *Camas*, a food plant of Native Americans. In the absence of burning, Douglas-fir trees flourished during the last century.





Sketch of the garden area of Hendricks Park,
showing features used to locate ferns.

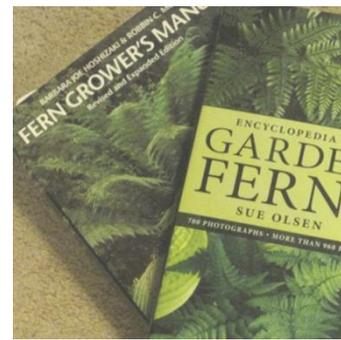
Identifying Ferns



In the course of this venture, I built up a small library of professional fern literature. These books are fine when I know where a fern might come from, but there are more than 12,000 species of ferns worldwide and hundreds of cultivars that may not look very like their parents. So how does one go about identifying one of the introduced species that may have come from anywhere in the world and is now in the park's Rhododendron Garden?

As a starting point, I used two books, both published by Timber Press of Portland, Ore. The first was the 2001 revised edition of *Fern Grower's Manual* by Barbara Joe Hoshizaki and Robbin C. Moran, which gives detailed descriptions of some 700 species of ferns with clear diagnostic drawings. The second was

Encyclopedia of Garden Ferns by Sue Olsen (2007), which describes nearly a thousand ferns that might be grown in temperate gardens. Over half the ferns are portrayed in beautiful color photographs. I used various Web resources to supplement the information in those books, including descriptions and reference photographs of ferns provided by



botanical gardens, universities and government agencies from around the world. I also used the resources of the Hardy Fern Foundation and the American Fern Society in the United States and the British Pteridological Society in the United Kingdom. And I have built up a small reference collection of living ferns (fewer than 100 varieties) in my house, garage and garden. This has proved invaluable for studying variations within species or varieties over the course of the year.



The dominant fern in the forest of Hendricks Park is the western sword fern, *Polystichum munitum*, though *Dryopteris arguta*, the coastal shield fern, can be found at altitudes above 600 feet. Other fern species are limited largely to the Rhododendron and Native Plant gardens, but ferns from private gardens have encroached over the park's boundaries.

Fern Reproduction

SEXUAL AND VEGETATIVE

The typical fern is diploid, having two matching sets of chromosomes. It produces haploid spores, which have only one of each chromosome pair and therefore half the diploid chromosome number. The spores are produced in sporangia that cluster together on the underside of typical fern fronds. The clusters are called sori (singular sorus), and they may have a protective cover or indusium. The appearance of the sorus and its indusium is often used in taxonomy.

The haploid spores are catapulted into the air from the sporangia, and may travel vast distances before settling. A spore that lands on a suitable surface germinates to produce a small (typically less than 0.25 inches in diameter) haploid plate of cells called a gametophyte or prothallus, which develops male and female sex organs on its underside. When water is present, haploid sperm swim to fertilize a haploid egg cell, and the resulting diploid zygote develops into a new diploid sporophyte fern. Eggs and sperm mature at different times, promoting cross-fertilization.

In a small percentage of species, particularly those living where water is not readily available, the life cycle is curtailed and the diploid sporophyte produces atypical diploid spores that form a new sporophyte without producing sexual organs. This asexual reproduction is called apogamia, which also occurs when a sporophyte has three sets of chromosomes (triploid) rather than the usual two. Triploids may arise as hybrids between species, and because they have an odd number of chromosome sets, they are incapable of pairing up chromosomes before separating them to form haploid spores. In some cases, apogamia may be viewed as a temporary evolutionary solution to reproduction in otherwise sterile hybrids. The long-term solution is a doubling of the chromosome number, which then allows the chromosomes to pair. Doubling, which has occurred many times during fern evolution, can occur if chromosomes divide but the cell does not. The record may be held by an adderstongue fern, *Ophioglossum reticulatum*, which has about 630 pairs or 1260 chromosomes per cell! (If you have ever tried counting chromosomes, you will understand why I mention this.)

Ferns produce millions of spores, allowing species to spread over wide areas. But in spite of all this activity, vegetative reproduction—without spores or gamete—is at least as important. Various forms of vegetative reproduction, such as the formation of bud-like structures (called bulbils) that grow into new ferns or creeping underground stems (rhizomes) that also form new plants, occur in ferns as in many other plants.

Anatomy

BASIC STRUCTURE OF THE FROND



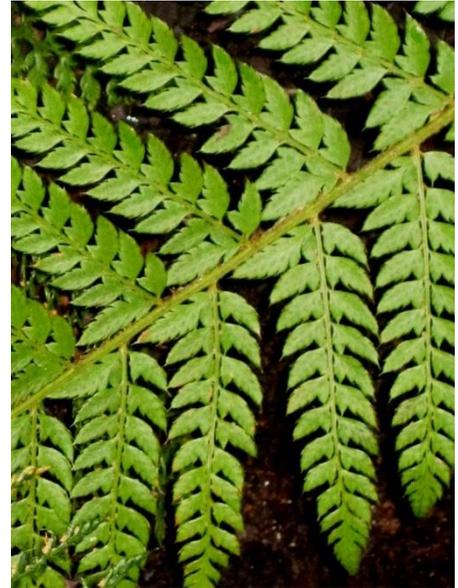
Fern leaves are called fronds, which may be simple in structure as in the hart's tongue fern, *Phyllitis scolopendrium*, illustrated above.

(Right) Fronds are more typically divided into finger-like leaflets (pinnae), as in the licorice fern, *Polypodium glycyrrhiza*.



In *Dryopteris wallichiana*, the leaflets (pinnae) are divided into smaller leaflets (pinnules), but the divisions are not complete. Leaflets that are stalked are said to be pinnate; even those that are not obviously stalked but are attached to the leaf at a single point are also called pinnate. But if each leaflet is attached to the leaf more broadly along the whole width of the leaflet, it is pinnatifid not pinnate.

In *Polystichum setiferum*, the frond is bi-pinnate or 2-pinnate, which means that the leaves are divided twice and each leaflet has either a stalk or is attached at a single point. The short stems to the leaflets are most easily seen at the base of the leaves. Conversely, the detailed structure is hardest to decipher in the youngest part of the frond, which is the growing tip of the leaf. As ferns mature, their leaflets go through developmental stages from pinnatifid to pinnate. When describing a frond, it is important to consider the more mature parts to determine the ultimate developmental stage the frond may achieve.



The basal leaflet (pinnule) on the side of the primary leaflet closest to the tip of the frond is larger than the others. This gives each primary leaflet (pinna) an outline similar to those of the sword fern, *P. munitum*. It is characteristic (though not unique) of the genus *Polystichum*.



mid vein of leaf (rachis of frond)

secondary leaflet (pinnule)

Shape of primary leaflet (pinna) with its pinnules is characteristic of the genus *Polystichum*.

(Right) Part of the expanded basal leaflet (pinnule) of a 'multilobum' cultivar of *Polystichum setiferum* is pictured from the lower right diagonally, showing further division into smaller and yet smaller leaflets, both stalked (pinnate). You can see that the smallest pinnate leaflets have lobes that are the start of a fifth subdivision of the frond that is so far only pinnatifid. The multilobum frond is thus 4-pinnate pinnatifid. You will need to understand the difference between pinnate and pinnatifid if you wish to read the fern literature.



CROZIERS

Unfolding fern fronds are termed croziers (more commonly known as fiddleheads because they look like the coiled head of a violin). They are seen here in the ostrich fern, *Matteuccia struthiopteris*.



SORI AND SPORANGIA

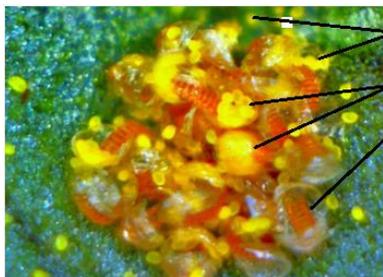
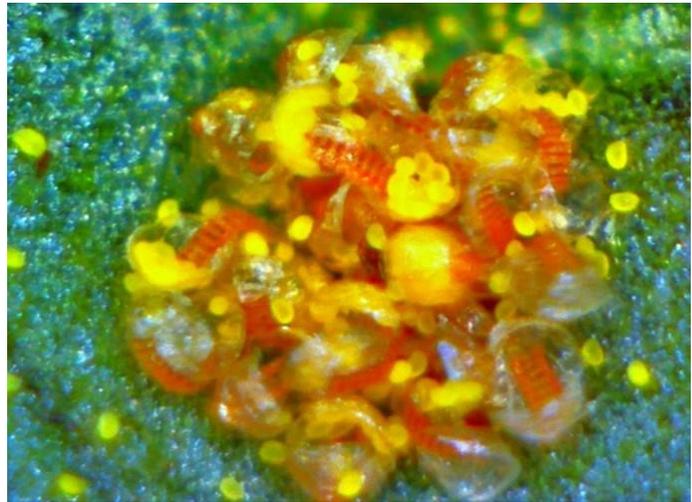


The typical fern produces spores from sporangia arranged in groups called sori, usually found on the underside of the frond. The simplest sorus consists of unprotected beadlike spherical sporangia.

The colorful sori on the left belong to a Japanese fern that has become endemic in Oregon, *Cyrtomium fortunei*. This genus typically has peltate indusia that appear to be lost from this specimen.

Adding to our color scheme is the sorus below, about 1 mm in diameter, from an Oregon native, *Polypodium glycyrrhiza*, the licorice fern. The individual yellow spores (0.07 x 0.05 mm) had recently been released from most of the sporangia, which had

almost transparent walls, apart from a band of orange bars that marked the position of the annulus (ring). This band of thick-walled cells eventually dried out and contracted explosively, propelling any spores remaining in the sporangium into the air and away from the frond. Most of the sporangia around the periphery of the sorus from 2 o'clock to 8 o'clock were empty, but one sporangium just to the right of the middle of the sorus was packed with yellow spores. This species has only 16 relatively large spores in each sporangium. These presumably diploid spores produce prothalli that do not produce gametes, so they develop into a new diploid sporophyte plant without the intervention of sexual reproduction. They are bigger than usual because the sporangial cells divide four times instead of the more typical six times seen in ferns that produce 64 haploid spores.



spores

sporangia

ladder-like thick cell wall in wall of empty sporangium

INDUSIA

The sori described above are naked and therefore unprotected. More typically, sori are protected, at least during development, by a flap of tissue called an indusium. Indusia have different forms that are often characteristic of the genus. Thus, lady ferns (genus *Athyrium*) typically have curved indusia attached along one side, while *Polystichum* has circular, centrally attached indusia that look rather like open umbrellas. The chain ferns (genus *Woodwardia*) have linear sori arranged rather like embroidered chain stitches, whereas the indusia commonly seen in *Dryopteris* are shaped like beans or horseshoes.



(Left) Curved indusia on the underside of a young frond of *Athyrium filix-femina cyclosorum*.

(Right) The indusia of *Dryopteris arguta*, the coastal wood fern, are typical of this genus.



Further detail can be seen (right) in the close-up of the sori of a closely related species, *D. carthusiana*. A line that is usually visible along one radius of the sorus marks the attachment of the indusium to the leaflet. The sori typically darken as they mature, and the indusia may shrink, exposing the mature sporangia. In this species, they are black, in contrast to the grayish-white indusia.



In some ferns, the sori are protected by folds of the leaflet instead of by typical indusia. In this view (left) of the underside of *Adiantum pedatum*, an East Coast maidenhair fern, the anterior edge of the leaflet is folded down to cover the developing sporangia, producing a line of light green sori along the lower front edge of each leaflet.



Variability

DEVELOPMENTAL: THE WESTERN SWORD FERN

The following photographs of a series of progressively older western sword ferns, *Polystichum munitum*, illustrate differences in fern form during development. Without knowledge of such maturational changes, we might misidentify young sword ferns as another species.



(Right) The first leaves of a young sporophyte of the sword fern. The plant is 1.5cm tall. Typically only a single young sporophyte grows from a gametophyte but the plant in the photograph was the largest of three young sporophyte plants that grew from a single gametophyte

(Below) Young sword ferns growing in an area of the forest that supports only this species. Only by watching these ferns mature was it possible to ascertain the species.



(Right) These young ferns are maturing to the stage at which we can be sure of the genus. But only with a mature fern (see next page) can we be sure that we are looking at the western sword fern, *Polystichum munitum*, rather than at *P. imbricans*, the dwarf or rock sword fern.





(Left) A year later, the plant started to look more like a sword fern.



Although the ferns on the right are mature, they are not the largest sword ferns in this area. Some have fronds almost 6 feet (2 meters) long.

Below: In the forest of Hendricks Park there is a clump about 5 feet in diameter that I watched grow from a single plant. The beautiful seat in the background, constructed of lumber from a tree that fell in the park during a storm, commemorates the life of Sydney "Syd" Bonzer, a young woman who loved running in this park.



SEASONAL: EVERGREEN OR DECIDUOUS

Some ferns are evergreen and some deciduous, but there are variations. The licorice fern is wintergreen: it has green fronds in winter that fall in summer—the opposite of the typically deciduous lady fern. Some ferns, including some *Cyrtomium* species, may be deciduous in cold climates but evergreen in warmer regions. Other ferns may have two forms of fronds, one being deciduous and the other evergreen. Such ferns, including some *Dryopteris* species, are sometimes called semi-evergreen.

GENETIC: CULTIVARS

Cultivars are not subspecies; they are genetic variants that may either breed true or can be maintained by vegetative reproduction. Many fern cultivars were discovered and named at the height of the fern madness in England more than 150 years ago. Although some of the names have become well established, they often do not fit the naming requirements of the International Commission on Plant Nomenclature. As I



do not intend my list to be a serious work of taxonomy, I will not change the names of cultivars, which will be listed in single quotation marks after scientific names.

Above: The tatting fern is a cultivar of the lady fern. The mutation appears to be unstable, and two yellowish fronds (at 1 o'clock and 4 o'clock) are reverting back to the wild form.

(Right) This fern is a cultivar of *Dryopteris dilatata* termed 'lepidota cristata.' Cultivars of this species can appear so different you might think you have different genera rather than genetic variations within a species. In the spring in Hendricks Park, this and other cultivars of this species synchronously develop reproductive sori that are alike in size, shape and color. This makes it easier to identify them as members of the same species.





(Left) A 'plumose' cultivar of *Polystichum setiferum*. What is probably a single mutation has a profound effect on the fern's appearance. The basic skeleton of the frond is shortened. As a result, the various elements of the frond—the leaf and leaflets—are crowded together and overlapping. As an additional consequence, plumose ferns can be dwarf.

CHECKLIST

This list is in alphabetical order by genera. An index to the genera of ferns found in Hendricks Park with a checklist of species, subspecies and cultivars, with their common names, starts on page 93.

Adiantum

The maidenhair fern has sori on the edges of its leaflets. The leading edge of the leaflet curls over to form a false indusium, which protects the sorus.



A. aleuticum

The western maidenhair fern is native to this area, extending from California to Alaska. In Hendricks Park, there are clumps of *Adiantum aleuticum* (photographed above) to the left of the path leading to the giant steps from the path that runs along Summit. A second patch is west of the rainbow bench, while in the northern edge of bed #10 two clumps are growing behind a prominent group of *Polypodium*.

A. pedatum

The northern maidenhair fern or five finger fern has long been confused with *A. aleuticum* (which some people regard as a subspecies of *A. pedatum*). *A. pedatum* is native from the Midwest to the Atlantic coast. Both species are deciduous. In Hendricks Park, *A. pedatum* loses its leaves earlier in the

fall than *A. aleuticum*, which still had some green fronds in January 2012. When I started these observations, there were scattered specimens of *A. pedatum* throughout bed #10. These declined in number during 2010 and further in 2011. By 2013, *A. pedatum* had disappeared from the park, and only *A. aleuticum* remained.

Each sorus is divided into four or five segments in *A. pedatum* (below left) and into six or more in *A. aleuticum* (below right). It is not hard to differentiate the species when sori are present.



Overlapping vegetative characteristics can help distinguish the two species at other times (the extra leaflets between the branching points of the leaves are characteristic of *A. aleuticum* but somewhat rarer in *A. pedatum*). For reliable identification, wait for spring and the development of new growth with fresh sori.

A. venustum

Himalayan maidenhair



Adiantum venustum specimens obtained from Roger Gossler (Gossler Farms Nursery, Springfield, Ore.) grow well in my garden.

According to Roger Gossler's catalog, this species is often grown as a groundcover beneath rhododendrons. It appears to have been introduced into the Rhododendron Garden several times. In 2011, it was growing along with rhododendron cuttings in the park's plant propagation area known as the lathe house. However, the fern has not become well established, possibly because park staff and volunteers tend to pay less attention to ferns growing in the same pots as rhododendrons!

There are many other exotic maidenhair ferns in Eugene. So far, none have become established in Hendricks Park.

Asplenium

See also *Phyllitis* for hart's tongue fern, which used to be included in the genus *Asplenium*. The separation of *Phyllitis* (together with some other ferns) from *Asplenium* was probably a mistake. I persist with the change because the name *Phyllitis* has become standard in horticulture and consequently in most fern literature. This does create a problem in defining the genus separately from *Phyllitis*.

Asplenium spp., the spleenworts, have long, narrow sori with indusia that are attached along one edge to the pinnules at an angle to the main vein. The form of the frond is very variable in this genus.



A. trichomanes trichomanes

I have seen the maidenhair spleenwort on retaining walls in private gardens near the park. Within the park, it was one of the original plantings in the new bed at the junction of Birch Lane and Summit Avenue in 2010. The plants, which were purchased from Mark Bloom of Bloom River Nursery, are doing well there, and appear to be reproducing. That is surprising, because this fern usually grows in calcium-rich soil. However, a subspecies, *A. trichomanes trichomanes*, does better in acid soils, so we probably have this sub-species in Hendricks Park. When it was young, *A. trichomanes trichomanes* grew as a prostrate rosette. By summer 2012, it had assumed a more upright form.

Athyrium

The lady ferns have much divided fronds somewhat similar to *Dryopteris*. However, the sori are very different, typically being curved and attached to the fronds along the inner curve of the indusium.

This genus includes several types of lady fern. Of the three native to Lane County, two are present in the park. The one that is not in the park, *A. americanum* (the alpine lady fern), is unusual for the genus *Athyrium* because the sorus has no indusium. Therefore, the sporangia are free on the surface. The other two lady ferns native to Lane County are subspecies of *A. filix-femina*.

A. filix-femina filix-femina

The common lady fern is seen (below) growing alongside the path along Summit Avenue.





Both *Athyrium filix-femina filix-femina*, the common lady fern, and *Athyrium filix-femina cyclosorum*, the subarctic lady fern (see p. 29), are deciduous and native to the park. They can be seen living side by side in a single clump of ferns (from the main entrance to the garden, turn left on the first path, and examine the first clump of lady ferns on the right). The subarctic lady ferns are closest to the path. They have typical J-shaped or comma-shaped sori close to the midline of the pinnule. The sori are light in color, varying from yellow to light brown, and the spores are yellow, maturing to a light orange/brown. By contrast, the sori of the common form are more variable in shape and located closer to the pinnule margin. Also, the sori and spores are darker in the common lady fern. In this clump, the two forms show other differences: the subarctic lady fern has narrower pinnules that change in form more slowly from pinnate/pinnatifid to bipinnate from the tip to the base of the frond than in the common fern, eventually becoming tripinnate toward the base of the frond. Note: when comparing the two lady ferns in this clump, do not include the *Dryopteris* that is to their right.



A. filix-femina filix-femina 'Frizelliae' or 'tattooing fern.' This bizarre cultivar (above) was photographed in the Oak Knoll among *Camas* in 2013. Such cultivars were developed in large numbers in nineteenth century England.



A. filix-femina cyclosorum

The subarctic lady fern (above) has sori that darken in late summer but are never as dark as those of the common lady fern. In Eugene, they mature to dark green but never to dark brown.

This clump containing both subspecies was identified in 2011 but, by 2012, one of the common ferns had died. If this trend continues, you could compare the subarctic ferns adjacent to this path with a large solitary fern of the common type located by the path along Summit. It is a few feet from the path at the second water post up the hill from the junction of the main Summit path and the turning to the giant steps.

The terminology of these two subspecies is confusing. While the common lady fern may be common worldwide, it is much less common in the park than the subarctic subspecies. Also, the name “subarctic lady fern” is not well known and is easily confused with that of the arctic lady fern, which is absent from the park.

You may wonder why I appear so confident that the common lady fern, *Athyrium filix-femina filix-femina*, which is so rare in this park, has been correctly identified. Remember that this fern comes from England. (No, it is not that I have a great memory but...) Also, remember that most of the cultivars of these ferns originated in England in the nineteenth century. This means that many of the cultivars in my garden will be the common subspecies and, if and when they revert back, they will provide a reference collection of the common subspecies that can be compared with the ferns in the park. Using just a simple hand lens, I watched as these ferns changed with the seasons. Well before the second year, I decided that the so-called “common” subspecies, which is actually rather uncommon in Hendricks Park, appeared the same as reference material in my garden, while the commoner subarctic subspecies, *A. filix-femina cyclosorum*, was distinctly different. From these observations, I have confidence that the common subspecies has been correctly identified.

The differences between the two subspecies as found in this park are both anatomical and, more strikingly, due to timing. The subarctic fern described here differs slightly from the typical description of this subspecies in that those from the park have orange or light brown spores and sori rather than yellow ones. A possible explanation could be that I look at the spores by reflected light whereas the original describers looked at them by transmitted light on a microscope slide. It could also be due to the time of year at which the observations were made. I find that, in Oregon, the spores and sori darken as the season progresses. As Oregon is nearly a thousand miles north of the Californian population, there could well be seasonal differences between the two populations. A more intriguing explanation may be that Hendricks Park, being midway between the northern and southern boundaries of the state, lies at the transition between the subarctic subspecies and the Californian one. As I read the descriptions of the two subspecies, the major difference I noted was the color of the sori and spores. I leave it for others to decide whether this could represent a gradual transition between the subspecies or a hybrid of the two.

A. filix-femina angustum Lady in Red

As far as I know, this is the only cultivar that is derived from an American lady fern. The parent subspecies is the northern lady fern endemic in the Northeastern USA and Canada. Lady in Red sometimes loses its red color and reverts back to the wild form. Moreover, nitrogen fertilizer can inhibit the development of the red color, which also might not occur until after the second winter. This can only further complicate the identification of lady ferns in the park.



A. niponicum pictum, Japanese painted fern.

During a guided tour of Hendricks Park in the spring of 2013, former head gardener Michael Robert mentioned that Japanese painted ferns were introduced into the Rhododendron Garden in the 1970s. These ferns are very variable in color, and can be beautiful with their pink, rose-red, gray and silver contrasting stripes on the frond. By 2000, they had all disappeared. But in 2012, a young fern, presumably arisen from spores, appeared among the lady ferns near the path mentioned above. In 2013, this fern developed elongate sori, suggesting that it was possibly a Japanese painted fern. But by the end of 2013, it had developed more mature fronds that were characteristic of another Asian species, *Athyrium otophorum*.

A. otophorum

The eared lady fern is another Asian species that grows well in Eugene.



The fern is seen (left) growing in the park, and a detail of an eared pinnule showing the sori is shown to the right of it (below).

There is at this time a single specimen of this species that appeared spontaneously in the garden in 2012. It was at first thought to be the Japanese lady fern seen above. Less colorful than the Japanese fern, the eared lady fern is, nevertheless, an attractive plant. It is doing well in the garden, and appears to be here to stay.



Azolla

A. mexicana

The mosquito ferns float on still pond water. They have much-reduced leaves, about 1 mm in both



length and diameter. The leaves are paired. The upper ones of each pair are initially green, but as they mature the color changes toward red or purple. *Azolla* provides anaerobic conditions within these cells suitable for the growth of the photosynthetic nitrogen-fixing bacterium *Anabena*, which lives symbiotically within the fern's cells. The lower leaf of each pair is a transparent sac that provides buoyancy. Reproduction is mainly vegetative. But when spores are produced, there are two types: very large spores called macrospores (female) and small (male) spores. The latter divide to produce a handful of cells, most of which are sperm. They fertilize the ova produced by the macrospores. The fertilized ova then develop into new ferns.

In 2013, I observed Canada geese on the lawn in the Rhododendron Garden. Earlier, I had seen geese in both of the park's water features. I also had seen dried-up remains of *Lemna minor* (duckweed, a flowering plant) near the memorial fountain on the east side of the lawn. So I wondered whether these birds might have carried aquatic plant material to the park. At that time, the fountain was completely dry, but there was a small amount of water in the west water feature. I sampled that and found not only duckweed but also another flowering plant, water lettuce, along with a specimen of the fern *Azolla*. I had to culture the water lettuce and *Azolla* before I could identify them, because the original specimens were so small. The fern was probably *A. mexicana* but, in the absence of reproductive structures, I could not make a positive identification.

Blechnum



Deer ferns superficially resemble sword ferns. However, they have two types of fronds: vegetative and reproductive. The latter are more upright and narrower, and they bear elongated sori with transparent indusia. In both types of frond, the pinnae are attached at their base rather than being stalked. Thus, they are pinnatifid rather than pinnate. The pinnae roll into tubes to protect the sori. There are perhaps two hundred species in this genus of which over thirty might be grown in Eugene. The sexually mature deer ferns in the park range in size from a few inches for the few miniature ferns, *B. penn-marina*, to the larger ferns, which fall into two groups: those in bed #7 and the remainder. Both groups are probably part of the highly variable species *B. spicant*.

B. penna-marina

This miniature deer fern has fronds that may be only 0.5 inches (1.2 cm) broad. It is native to Australia, New Zealand and South America, but has also become endemic in Oregon. Like its big brother, this fern produces spores on reproductive fronds, but they are difficult to germinate. Therefore, reproduction is mainly vegetative by rhizomes that form runners. In late 2013, specimens of this fern were scattered around the rainbow bench in the Rhododendron Garden.



B. spicant

This deer fern, native to the Pacific Northwest, is found in the forested part of the park, the southern part of the Native Plant Garden and the Rhododendron Garden. It is very intolerant of lime. *B. spicant* is known to be genetically variable, with over 80 varieties. Specimens in bed #7 differ in many ways from typical *B. spicant* as they are larger than most deer ferns in the park and more prostrate, with shorter fertile fronds. These specimens do not appear to tolerate the cold as well as typical *B. spicant*. These ferns were obtained from Gossler Farm and Nursery many years ago. They do not seem to belong to another species but certainly differ from currently obtainable horticultural deer ferns.

B. spicant grows in both the Rhododendron and Native Plant gardens, where it receives some additional water. It also grows in the forest, where it does not do very well. In contrast, it grows particularly well along a stream in Yachats (Gerdemann Botanic Preserve, see right), where it may reach a height of over 5 feet, which is double the normal maximum given in most reference works. This also represents six times the height to which this species typically grows when planted in the southeast U.S. The deer ferns are not unique in this respect: several ferns grow much larger in the northwest than in the rest of the U.S.



Cheilanthes

Lip ferns are so called because of the rolled-up edges of the pinnules that protect the sori. Some 200 species live in rocky dry soils, often under desert conditions.



C. lanosa

Hairy lip fern

The hairy lip fern is not the sort of fern you would expect to find in rain-soaked Eugene. It is native to the eastern United States from Texas to New England. In Eugene, plants were included in the rock garden when it was constructed in 2003. Only one was surviving in 2013.

Cyrtomium

This genus, the holly ferns, is similar to *Polystichum*. Both have peltate (umbrella-like) indusia, but *Cyrtomium* has a terminal pinnule, and the frond's veins are netted.

C. fortuneii var. *intermedium*



The hardy Japanese holly fern, or Fortune's holly fern, is native to S.E. Asia but escaped to become endemic in Oregon. A single specimen of what I suspect is var. *intermedium* (a prostrate variety) is uphill from the rainbow bench. Evergreen and apogamous, with paired oblong pinnae, this fern has sori in rows parallel to the mid veins of each leaflet. It is prostrate, with a rosette of light green fronds.

C. falcatum



The Japanese holly fern is another species that has escaped into the wild in Oregon. It grows well in my garden, and showed up in the park in 2013. The cultivar in the park appears to be 'butterfieldii.' It has pinnules with serrated edges.

A hybrid, possibly of the two species mentioned above, is growing in both the park and my garden, but the two plants have yet to produce sori.

Cystopteris

Fragile ferns and bladder ferns have creeping rhizomes and round sori covered with hood-like indusia.

C. fragilis



The deciduous fragile fern is native to the Pacific Northwest but widely distributed around the world. It often looks rather scruffy because its fronds, living up to the species' popular name, are brittle and easily broken by the wind or a passing animal.

This common fern is easily overlooked as it resembles a young or poorly developed lady fern. But *C. fragilis* has only hairs on the vein and stalk, whereas lady ferns may have scales. However, I have seen some hairless *C. fragilis* specimens and some lady ferns with few, if any, scales. (Some taxonomists used to spend their time splitting hairs.) In the absence of sori, these ferns are very difficult to differentiate, but when sori are present, they are quite different. The young sori of the typical lady fern are comma-shaped in the youngest leaflets, whereas *Cystopteris* has bowl-like pockets from which sporangia peek out at the top. It is hard to tell how many of these ferns are in Hendricks Park. In 2011, there was an easily identifiable specimen just uphill from the main (lower) path leading east from the rainbow bench. Another probable specimen was growing nearby, a little closer to the path, but this one had no sori and so could not be identified unambiguously. Other probable members of this species have been seen throughout the park, often where extraneous rock or gravel has been introduced. Possibly, the rocks have included some limestone, which would raise the pH of the soil to a level more suitable for *Cystopteris* than that typical of Hendricks Park, with its acidic soil that is ideal for rhododendrons.

Dryopteris

A large genus with perhaps 200 or more species, *Dryopteris*—the wood ferns—is characterized by the form of the indusium, which can be kidney-shaped or C-shaped. This genus lacks hairs except for very short glandular hairs in a few species. Scales are common. A groove on the upper side of the leaf stalk is continuous with the groove of the main veins of the leaf and its leaflets. *Dryopteris* is very similar to *Polystichum*, but the latter has circular indusia and discontinuous grooves.

Many *Dryopteris* species are hardy in this area. The names of a few species commonly found in adjacent gardens (and which could turn up in the park at any time) are included here, without photographs, for future reference.

D. affinis



Dryopteris affinis



D. affinis is evergreen and pinnate-pinnatifid to bipinnate. This English fern has been the base for a number of cultivars; however, the only form in the park is the basic species. Its fronds are rather like those of *D. wallichiana*—both have parallel-sided pinnules (secondary leaflets). However, in this species both the stems and leaves are mid-green,

whereas the stems and veins of the leaves of *D. wallichiana* are much darker.

A few specimens are scattered through the garden. On the undersides of the leaves of *D. affinis*, where the leaflets branch off from the main leaf vein, most of the smaller veins have a dark spot or patch. Hint: use a lens.

Right: *D. affinis* showing a spot of dark pigment at the base of a pinna. The main leaf rib is at the bottom of this photograph.



D. arguta



The coastal or western wood fern is native to the Pacific Northwest. It is best seen in the southern part of the park's forested area, above the 600-ft contour. Although all *Dryopteris* species are noted for their variability and tendency to hybridize with each other, it is said that *D. arguta* does not hybridize with other *Dryopteris* species. Nevertheless, leaflets from fronds of *Dryopteris arguta* that appear similar to two other N.W. species, *D. carthusiana* and *D. filix-mas*, can be

found in the park, as can atypical fronds that are halfway in shape between *D. arguta* and *D. carthusiana*. However *D. carthusiana*, the spiny wood fern (which has different common names around the world), is native to temperate areas of Asia, Europe and North America (including the N.W.), but is not found in the wild in the Eugene area (but it may be in the garden). So perhaps the variation in form of *D. arguta* in this park is simply a consequence of the variability typical of *Dryopteris* species. I believe this is another example that merits a detailed DNA analysis.



Dryopteris arguta in Hendricks forest

D. bisettiana*—see *D. erythrosora

D. carthusiana



The spinulose wood fern has large, irregular clumps of fronds. It is typically deciduous but, in very mild areas, it behaves as a perennial, like *D. crassirhizoma*. Two-pinnate to two-pinnate-pinnatifid, *D. carthusiana* has toothed margins to leaflets and gray indusia. A single specimen is found apart from others in the clump of lady ferns on the first turn to the left after you enter the park from Skyline Blvd.

D. crassirhizoma

The thick-stemmed wood fern can have an enormous rhizome that makes a very large clump of fronds. It is best characterized by its behavior: it collapses after the first frost, placing its fronds flat on the ground. The fronds remain green and continue to photosynthesize until new fronds appear the following spring, giving a shuttlecock-like appearance. By that time, the older fronds are covered with leaves and other woodland debris.



D. cystolepidota (C. nipponensis)



Native to forests of Japan and Korea, this evergreen and apogamous plant appears to have a creeping rhizome, judging by the line of plants in the bed across the path from bed #11. The lowest pinna (primary leaflet) has a short first pinnule (secondary leaflet) adjacent to the rachis (main rib or vein of the

leaf), while the second pinnule is the longest.

D. cycadina



D. cycadina specimen from Roger Gossler.

Dryopteris cycadina, the shaggy wood fern. The fronds of this apogamous evergreen are once-pinnate with narrow pointed, yellowish-green and slightly scalloped pinnae. The central veins of the pinnae are darker green. The black scales of this species contrast with the light green fronds. Two specimens are found in the park to the right of the giant steps, and additional plants are on the path at the top of the steps. The original specimens were a gift from Roger Gossler, who has had them in his catalog for many years. The species is native to wet woodlands of Asia, from India to Japan.

D. dickinsii



D. dickinsii is rather like *D. cycadina*, but it lacks the black scales.

D. dilatata (*D. austriaca*) 'recurved form' ('Recurvata')



Semi-evergreen and native to Europe and Asia, *D. dilatata* is often difficult to distinguish from *D. expansa*. However, some of our specimens are of the recurved form, with the margins of the leaflets curved under. The old name for the cultivar was '*Recurvata*.' This Latinized, melodious name, *D. dilatata* '*Recurvata*,' was banned under international naming conventions, so 'Recurved Form' is often substituted. However, this new form of the name also runs afoul of the naming conventions, as it is descriptive. Such rules seem stupid when they result in the loss of well-known old names. So I think we should use the older name until the next time the rules are revised. But whatever its name, this cultivar is typical of *D. dilatata*. There is a specimen in the non-forested area of the Native Plant Garden. The basal primary leaflets (pinnae) are asymmetric because the secondary leaflets are longer on the basal side. This would appear to confirm the identification.

D. dilatata 'Lepidota Cristata'



This cultivar is so different from the base form of the species that it could easily be mistaken for another species. Indeed, Rickard suggested that it may be derived from *D. expansa* rather than *D. dilatata*, so once again we need DNA studies. There are two typical specimens of this cultivar on either side of the front of the rainbow bench. In addition, a leggy specimen is found in bed #11, next to the non-return valve for the watering system. This poor fern was probably grown from spores rather than vegetative. Such sexually reproduced versions of this cultivar are large and brittle, so they are easily blown over, as seems to happen every year. In 2013, two more specimens were discovered in the now-familiar bed of lady ferns on the first turning on the left after the entrance to the park from Skyline Blvd. From their size, it is clear that they had recently grown from spores.



***D. dilatata* (partly reverted to its natural form)**

This smaller fern was next to the recurved fern in the Native Plant Garden; another was on the slope above the rainbow bench. Neither fern had sori, which made definitive identification impossible. But as the seasons changed, the sori appeared identical in both ferns and also to the cultivars of *D. dilatata*. As both specimens are next to a cultivar of the same species, they might simply be reversions to the natural form of the species. As such, they might be oddities, as the natural form is rarely seen, often being replaced in nursery listings by a much more foliose form, *D. dilatata* 'Jimmy Dyce.'

D. erythrosora

The autumn fern is characterized by red sori and a variety of cultivars. With the exception of the beaded cultivar (*Prolifica*), it is not common in the park. It is notable for its new spring growth, which is a striking coral red. Fronds are characterized by elongate leaflets with slightly curved smooth outlines.

***D. erythrosora* 'Prolifica' (previously *P. varia*)**



Dryopteris erythrosora 'Prolifica'

Dryopteris erythrosora 'Prolifica' is one of a number of ferns sold under the name 'beaded fern.' These ferns are native to woodland areas in China, Korea and Japan.

Based its large size, vertical rhizome, brown scales and frond form, I initially identified the beaded wood fern of Hendricks Park as *D. varia* rather than as the more usual *D. bissettiana* or one of the several other species of beaded *Dryopteris* ferns, all of which appear to have started their taxonomic life as subspecies of *D. varia*. It seems that the beaded subspecies of *D. varia* is now considered synonymous with *D. erythrosora*.

If you take the path that runs past the rock garden (on the left) and crab apple trees (on the right), you will see a mixed group of ferns just before the next uphill path junction on the left. The group includes several 3-ft beaded wood ferns, which are easily identifiable by the pale bead-like spots on the upper surface of the fronds. The beads overlie the sori on the underside. New growth in the spring is a striking coral red that extends from the croziers to the whole of the young fronds. As the fronds mature, their color changes to the typical bronze green of the adult form. This in turn changes to bronze by fall.

This beaded form of *D. erythrosora* is quite different from the regular form of the same species. Bloom River Gardens had it conveniently next to the less beaded *D. bissettiana*, the better known beaded fern. The park specimens are clearly *D. erythrosora*.

D. expansa

D. filix-mas

D. formosana

D. goldiana

These species are listed here because they are common in gardens adjacent to the park but have yet to be found within the park's boundaries.

D. lepidopoda



The sunset fern, a perennial evergreen, is smaller than *D. wallichiana* but, as its name implies, even more colorful. Several plants of this species, obtained from Mark Bloom, were planted in 2010 in the new bed next to the junction of Summit Ave. and Birch Lane. In form, the fronds are similar to those of *D. wallichiana*, and both species are native to mountainous regions, though *D. lepidopoda* is limited to Asia.



Dryopteris lepidopoda

D. marginalis

D. pacifica

D. sieboldii

D. tokyoensis

Yet more common species found in nurseries and gardens. They may turn up in the park at any time.

D. varia*—see *D. erythrosora

D. wallichiana



D. wallichiana

Wallich's wood fern is a large perennial evergreen. This attractive species is not native to the Northwest but is found at high altitudes in Africa, Central America, South America, the Hawaiian Islands and Asia. Worldwide, there may be some variation in form, but in Hendricks Park the leaflets of the pinnate-pinnatifid to bipinnate fronds are unusually regular in shape from tip to base. They also have parallel sides, with their ends cut parallel to the base. New growth is bright yellow, maturing rapidly to a rich green. This contrasts with the dark leaf stem and dark scales of the leaf rib or vein.

There are several specimens of *D. wallichiana* in the park. Two obvious ones are close to the trail that begins across Skyline Blvd. opposite the entrance to the Rhododendron Garden. This trail continues through the beds to Birch Lane. To see another prominent group of Wallich's ferns, enter the Rhododendron Garden from Skyline and take the first trail on the left. The ferns are almost immediately on the left. Further specimens can be seen if you enter the garden from Parkside Lane, taking the right fork. The ferns are on the left.

D. spp. (species to be determined)

These evergreen, medium-sized ferns have elongate oval fronds, medium-length stems, brown scales and an upright rhizome. There are no obvious inequalities in the lower primary leaflets, which are shorter than those above them. The secondary leaflets have lobed sides, looking rather like a Dutch barn.

Many *Dryopteris* species are hardy in this area. Some species in local gardens that could turn up in the park at any time are listed here for future reference (see above). This list is not complete. There might be 100 or more species or distinct cultivars that could grow in the park. Given the variability within the genus *Dryopteris* and its tendency to form hybrids, it is a nightmare to identify new plants that turn up in Hendricks Park.



I am not the only person having difficulty identifying *Dryopteris* ferns. This labeled specimen is in the University of California Botanical Garden in Berkeley. At least they knew the origin of their specimen.

Equisetum

Equisetum, the scouring rushes and horsetails

In both types of *Equisetum*, leaves have been reduced to a ring of scales called teeth that hug the main stems. The photosynthetic function normally associated with leaves is taken over by the stems and, in the horsetails only, by additional whorls of side branches. In my mind, the distinction between the horsetails and rushes is not sufficient to justify classifying the two types as subgenera, because it is possible to find horsetails such as *E. ferrissii* (Ferriss' horsetail) that are hybrids of two species of scouring rush (*E. hyemale*, the common scouring rush, and *E. laevigatum*, the smooth scouring rush).

In the 1940s, when I first studied biology, *Equisetums* were regarded as primitive relatives of ferns. Later in the 20th century, DNA studies showed that they were indeed ferns.



Common horsetail

E. arvense

E. arvense, the common meadow horsetail, has separate reproductive and vegetative stems. The reproductive ones, which appear first in the spring, are light brown. The sporangia are pointed, cone-like swellings of the stem, and they last just long enough to produce spores. The hollow vegetative stems have 10 or 12 ridges, and their cavity is blocked at the nodes, as in all equisetums. The cavity occupies 25 percent of the stem's diameter. The stem's side branches, which are green, usually do not branch further.

E. fluviatile



The water or swamp horsetail has 16 ridges on the stem, which is otherwise fairly smooth. The hollow cavity occupies more than half the diameter of the stem, but less as it approaches the nodes. In summer, the plant has cones on otherwise vegetative stalks.



E. palustre

The marsh horsetail has 5–10 ridges on its stem, with deep grooves between. The central cavity is small, but it is surrounded by a ring of somewhat smaller cavities, which run together. If you break the stem, tissue breakage can create the impression of one large cavity.

An *Equisetum* hybrid



This hybrid is very similar to *E. sylvaticum*, but it does not have reproductive structures. The stem has 10 or more ridges, and the cavity occupies 30 percent of its diameter. Note the whorl of side branches that divide many times.

All three (or four) equisetums in the park are horsetails. Worldwide, a score of species belong to this genus, but very few are found in Oregon. Two species (*E. palustre*, the marsh horsetail, and *E. fluviatile*, the swamp or river horsetail) can be found along a stream that enters the park from drainage pipes that open near the *Gunnera* plants and proceeds alongside the path that parallels Summit Ave. Two more populations of *Equisetum* are higher up on the south-facing slope north of Summit, where the soil is much drier. One of those is *E. arvense*, the common or field horsetail. This prevalent weed covers the hillside above Summit, and it would be all over the garden but for the vigilance of the garden staff. The fourth horsetail population is very similar to *E. arvense* except that the whorls of side branches are also branched. At first glance, this might appear to be the first occurrence of *E. silvestris* in Oregon. However, I think it is more likely to be a hybrid between two of the species known to be in the garden. Also, I have yet to see any reproductive structures in this population. These plants appear to have been prevented from spreading by the path below the rock garden and the paths leading to the Park Lane entrance to the park. Judging from their anatomical features, I suggest that this population is a hybrid of *E. arvense* and *E. fluviatile*.

Gymnocarpium

The oak ferns lack an indusium, as the generic name implies.

G. dryopteris



At one time, this species was included in the genus *Dryopteris*. This included a number of wood ferns, including one that grew on oak. Hence the name “*dryopteris*” or “oak fern.” The rules of nomenclature at that time determined that the specific name should be *dryopteris*, even though this fern does not grow on oak. A literal translation of the specific name has given the name “oak fern” to this species.

This name has persisted in spite of being inappropriate.

The fronds of this species come up individually from an underground rhizome. They can crowd together, forming a ground cover. It is best to look at the characteristics of this species by looking at a single frond.



Gymnocarpium dryopteris

These ferns are characterized by the very large basal pinnae, which are approximately equal in size to the rest of the frond. This gives the superficial appearance of a frond with three pinnae. Comparing this species with bracken (*Pteridium*) suggests a possible mechanism for the evolution of the three-branched frond such as that found in bracken.

Isoetes

The quillworts are usually studied with the ferns, but they are a more primitive group.

These aquatic or semiaquatic evergreen plants have sporangia on the inner side of swollen bases of quill-like leaves.

I. nuttallii



Nuttall's quillwort is the only semiaquatic species in this area, as the other species are totally aquatic.

The specimen in the photograph was found in the wettest part of the park among the most water-dependent equisetums. It has a tri- or bi-lobed corm, which is not visible in the photo as it was hidden behind a mass of roots. A younger plant, looking like a short length of green thread, was trapped inside the outermost leaves.

Quillworts should not be confused with reeds, which are much larger.

Lycopodium

The club mosses have needle-like leaflets, sporangia and rounded cones. DNA studies show that these plants together with *Isoetes* and *Selaginella* are not ferns. However, like the ferns they have a vascular system and are more advanced than the true mosses. They also share with ferns reproduction by means of spores. These plants are termed fern allies and are usually studied with the ferns. They are therefore included in this checklist.



L. clavatum

L. clavatum

The running club moss, or running pine, has horizontal, snake-like stems that can reach 10 feet and give rise to occasional upright branches. The leaves have white bristles at their tips. Though not obvious in the park, this species can be seen at the Darlingtonia State Natural Park (Darlingtonia Wayside) north of Florence, Ore. This population was almost wiped out by low temperatures in January 2014. Fortunately, a neighboring population at Yachats illustrated in the photograph above still survives. Individuals of *Lycopodium* spp. found in the park beneath western sword ferns in November 2013 were almost certainly young shoots of *L. clavatum*. However, the bristles on the ends

of the leaves were green instead of white. The photograph below shows *L. clavatum* growing in a terrarium in my basement. The white bristles show quite clearly, though there are also some green ones.



This species is found in North and South America, Europe, Asia, Africa and Oceania. Not surprisingly, it has acquired a considerable number of common names. Such names used locally need not cause confusion. Because in some regions there is no agreement on which common name to use, I am combining what I consider to be the best two common names currently in use (running club moss and running pine) to produce a new common name: Running pine club moss. “Running” describes the habit or form of the plant, “pine” is what it looks like, and “club moss” is the group it belongs to.

It is frequently stated in the literature that this species is extremely hard to cultivate. I have had success with growing these plants from cuttings, and I give details here for those who wish to try their hand. The growing medium appears to be the main problem; I mix two parts of sand, one part of peat moss and one part of leaf mold. I inoculate this with a commercially available mix of mycorrhizal fungi and various bacteria (Granular Root Zone obtained from the distributor Down to Earth). An additional inoculant is a sample of soil in which healthy ferns have been growing. The resulting soil is used in a

terrarium; it is initially wetted with dilute (0.25 teaspoon/gallon) liquid fertilizer (Miracle Grow liquid all-purpose plant food) and thereafter watered with tap water.

The spores of this plant are little short of amazing. They are difficult to germinate, and it has been suggested that they may need to pass through the gut of an animal first. The spores are very hydrophobic: poured onto the surface of a bowl of water, they will prevent a hand getting wet. They are used as a mordant in dyeing, being more effective than aluminum compounds. The spores are flammable due to their high oil content, and were used in fireworks and early flash photography. They were also used in pharmacy and wood polishing. In microscopy, they were used for measurements of size and to determine the concentration of other particles. The spores of ancestral relatives of *Lycopodium* are a major component of coal. Although these plants are not well known today, their spores have been used by humans for many hundreds of years and probably since prehistoric times.

Matteuccia

Only one species is found in Hendricks Park.



Matteuccia struthiopteris in April, when fiddleheads (crozier) were unfolding.

M. struthiopteris* var. *pennsylvanica (often incorrectly spelled *pennsylvanica*), the American ostrich fern, is deciduous. Its dimorphic fronds, which emerge in early spring as showy edible fiddleheads, are pinnate-pinnatifid and completely sterile. The reproductive fronds, looking like dried flower heads, emerge in summer or fall. The light green spores do not mature until the spring, and they have a very short viable life. (A short life seems to be characteristic of pale spores.) Reproduction is mainly by buds on the aggressive shallow rhizomes. This species is very cold-tolerant, but it requires a lot of water to survive even moderate summer heat. It did not do well in the park in the summer of 2011, when the irrigation system broke down and there was no water for about a week. These ferns, located in a bed opposite the base of the giant steps, lost most of their sterile fronds early, and very few plants produced fertile fronds. The following year, there were fewer ferns in the bed, but in the next year or so, the population largely recovered.



Above: Sterile fronds. Note the absence of sori.

Right: Reproductive fronds appear in late summer. Spores develop in late winter or early spring. The fern to the right was photographed in February, as spores were being released.



A giant cultivar of this species that is available in some nurseries is said to grow to 6 feet, which would be twice the height of the ostrich ferns in the park. Sadly, the giant is usually a disappointment, because it tends to grow only a foot higher than its wild counterparts. Perhaps water is the limiting factor. Therefore, this cultivar is a surprise and challenge to fern growers in the Pacific Northwest. We are used to specimens much larger than those on the East Coast. After all, if we can grow a 6-foot deer fern, why couldn't we grow an ostrich fern that is 8 feet tall?

(Below) *Matteuccia struthiopteris* in early summer, at the height of its vegetative phase.



Onoclea

This genus has dimorphic fronds on long stalks that arise from shallow, creeping rhizomes. The sterile fronds are pinnatifid and deciduous, whereas the reproductive fronds are beaded and persist into the winter until they release their spores.



O. sensibilis

The sensitive fern is another deciduous species that was adversely affected by the irrigation system's failure in 2011. This fern is native to the East Coast of the USA, and it supposedly derived its common name from the early European settlers' observation that it dies back quickly at the first frost. These ferns are found in the bed adjacent to Summit Ave, just down the hill from the path that leads to the giant steps. The large clump is spreading by underground rhizomes.

Osmunda



Members of this genus have sporangia on much reduced pinnae that lack leaf-like tissue.

O. regalis

The royal fern is a small, bushy, deciduous fern whose leaves are quite unlike those of a typical fern. On the fronds, the spore-producing regions are separated from the vegetative parts. This species is so unlike ferns in appearance that some people call it the flowering fern.

A royal fern can be found at the bottom of the giant steps, to the right. Additional specimens can be seen in the same bed as *Onoclea* together with a cristate cultivar of *Osmunda*.

The royal fern (right) is the only species of *Osmunda* found in the park, but *Osmunda cinnamomea*, which looks more like a typical fern, can be found in neighboring private gardens.





Left: *Osmunda regalis* in the spring, showing the separation of leaves and terminal reproductive structures. The croziers on the right in the photograph show that this is indeed a fern.

Below: Mature pinnae of *Osmunda regalis*.



Pellaea

Cliff brakes and button ferns have a dark center line on their scales. Their sori are usually marginal, and the leaf edge is curled to protect the sporangia. These were the first nonindigenous ferns I noticed in the park.

P. falcata (cliff brake) and *P. rotundifolia* (button fern)



P. falcata (above)

Nurserymen will tell you that these plants will not survive outside in Eugene. But both species survived the extremely cold weather of December and January 2013/14.

P. rotundifolia (right)



Both are New Zealand natives. I found them along the southern edge of the park where *Vinca minor* is growing as a weed. Presumably, they came into the park with garden plants. *P. falcata* is established on a wall just outside the park, and also turned up on rocks within the park. There is no sign of the Oregon species of *Pellaea*, which is known as the coffee fern, *P. andromedifolia*.



More recently, I found a third species of *Pellaea*, *P. wrightiana*. This species comes from Mexico, which is a center for the genus.

P. wrightiana

Phyllitis

Phyllitis has strap-like fronds with lobes at the base. The linear sori are paired symmetrically, and they develop at an angle to the main vein, producing a series of V's.

This genus is closely related to *Asplenium*, with which it forms hybrids and from which it was split off, perhaps in error. The name *Phyllitis* is widely used in horticulture, and therefore will be used here.

Phyllitis (Asplenium) scolopendrium scolopendrium 'Undulatum'



A specimen of this species, the European hart's tongue fern, is located between rocks at the side of the path below the water feature on the garden's west side. It belongs to the undulatum group of cultivars. It has slightly wavy margins. There is a rare tetraploid native American form of this species, *P. scolopendrium americanum*, but the fern in the park is an obvious cultivar, which points to a diploid European origin. There are many cultivars: about 450 were known in England at the end of the 19th century, but many have been lost.

Pityrogramma

The gold-back and silver-back ferns. Their sporangia are not in sori but are scattered on the underside of the frond, which has a waxy coating.

P. triangularis

The gold-back fern has a waxy coating on cream-to-yellow fronds that remind me of oak ferns. The stalks are somewhat longer, and the lowest pinnules of the basal pinnae tend to extend into a swallow tail. The overall shape of the frond is triangular to pentagonal. These very small ferns often are only 4 inches tall and 2 inches across in the park, though under more favorable conditions they grow much larger. They require very well-drained soil. They are also found under drought conditions. It is not very well known that Eugene has one of the lowest summer rainfalls in the United States. So these ferns have responded by curling up and exposing the underside, which is yellow and much more visible under drought conditions. If you want to see these ferns, I suggest you wait until the end of summer, when you can look at the base of a rock surface and will probably find some specimens.

Polypodium

These ferns are rather small, with creeping rhizomes, fronds entire without pinnae or with relatively few pinnate or pinatifid pinnae, and circular or oval sori without protective indusia.



Polypodium glycyrrhiza growing at the Oak Knoll.

P. calirhyza will be described along with *P. glycyrrhiza*.

P. glycyrrhiza



The licorice fern is a deciduous wintergreen. It typically grows as an epiphyte on broadleaf maple, but also grows on the ground, especially on rocky surfaces. In the Oak Knoll, licorice ferns have spread in recent years from rocky outcrops to steep slopes below. Their spores prefer to germinate in disturbed soil, so this species has recently extended along the uphill sides of the new Oak Knoll trail. It is very variable in form, which can be short- or long-tailed. The long-tailed type is named '*longicaudatum*.'

P. glycyrrhiza '*longicaudatum*'

This form appears to arise spontaneously, and can be found in any large population of licorice ferns. As well as those in the Oak Knoll, there are concentrations of long-tailed licorice ferns below the water feature on the west side of the Rhododendron Garden. Another clump can be found flowing over a low rock wall on the east side of bed #10.

Geographic variants of *Polypodium glycyrrhiza* have increasingly become recognized as separate species. Whereas the typical *P. glycyrrhiza* has elongate, triangular pinnae without leaflets, the new species, *Polypodium calirhyza* (also known as *P. californicum*), has pinnae that are proportioned like human fingers with blunt rounded tips. They may on occasion be pointed, but they never become the long pointed pinnae typical of the commonest form of *P. glycyrrhiza*. *P. calirhyza* probably accounts for the previously unidentified *Polypodium* spp. seen in September 2011, which had fewer and larger

bright yellow sori when *P. glycyrrhiza* plants were just emerging and had not yet developed sori. It is also possible that the early yellow sori belonged to *P. glycyrrhiza* that had persisted through the summer as evergreen plants in the artificially watered Rhododendron Garden. I planned to check these possibilities during 2012. In January 2012, however, I found a *Polypodium* specimen in bed # 7 that, but for its large size, would have keyed out as *P. virginianum* (Virginia or rock polypody or American wall fern). This evergreen fern has elongate, narrow pinnae but, because of its large fronds, I now identify it as *P. calirhyza*.

Outside the boundary of Hendricks Park, at Judkin's point, is a small piece of parkland bounded by Skyline Blvd. and Birch Lane, known as Pre's Rock. It contains a memorial to Oregon runner Steve Prefontaine, who died in an auto accident at that spot on Skyline Blvd. in 1975. The amount of exposed rock at that site is much greater than in the Oak Knoll, and the abundant licorice ferns form homogenous patches of similar plants. Presumably, that population has been established for a long time and is closer to equilibrium than the recently disturbed licorice ferns in the Oak Knoll.

P. calirhyza is also found in Baja California, Mexico; therefore, its southern range extends far beyond that of *P. glycyrrhiza*. It is perhaps ironic that these ferns, which would not be expected to thrive in the park's acid soils, are found in the same bed as abnormal-looking deer ferns, which hate calcium. Perhaps lime might have been added inadvertently to the soil in this area.

Evolution in Action: Observations on the colonization of ground habitats by the typically epiphytic *P. glycyrrhiza*

When I moved to Eugene in 2000, the licorice ferns in the park were typically found on big-leaf maples and sometimes on exposed rock surfaces, including the occasional outcrop in the Rhododendron Garden, the low wall on the path side of bed #10, and rocks at the loop end of the Oak Knoll. At that time, there was no path except for a deer track from the junction of Madrona Drive and Malabar Drive. A road that had run into the Oak Knoll from Highland Avenue (presumably built when a lookout tower was constructed during WWII) was completely overgrown and difficult to find. When I visited the site with then-head gardener Michael Robert, I could see the remains of the tower's timbers and some hardware. By the time a new trail to the Oak Knoll was constructed, the remains of the tower had disappeared. Licorice ferns had covered the rocky outcrop, along with poison oak.

Where the trail from Highland Avenue met the trail down to the old drinking fountain, a number of big leaf maples had good colonies of licorice ferns on their branches. Also, as branches covered with licorice ferns fell off and rotted, the ferns survived, growing on the rotted wood and apparently also on the soil. These small groups of soil-living licorice ferns did not persist except on a rocky outcrop that might have been colonized independently. After the new Oak Knoll trail was built, the number of ferns growing on the soil surface increased rapidly. Fern spores germinate best on disturbed surfaces, a feature that was noted when the life cycle of ferns was first described. It is not surprising that ferns were among the first vascular plants to appear on rock at Mt. St. Helens after the devastating eruption of 1980.

The edges of the new Oak Knoll trail proved ideal for the settling of licorice fern spores, and colonization of the ground along the trail proceeded rapidly. There appears to have been enormous variability in the spores, as each initial plant appeared different from its neighbors. As time went by,

some of these specimens presumably died off, and the remaining ferns reproduced vegetatively, developing an extensive rhizome system. By 2010, there were larger areas of homogenous ferns that could be quite different from those in neighboring areas, making up a patchwork quilt of ferns. By 2012, the variety of ferns at the Oak Knoll had decreased enormously, though highly diverse new ferns were continuing to colonize the sides of the trail farther and farther from the original parent colonies in the Oak Knoll. In the largest population, the ferns were in large patches. Often, there appeared to be separation between similar ferns as though the plants were secreting something into the soil to inhibit the growth of their neighbors. Whatever the explanation, the ferns are forming larger clumps of similar—probably genetically identical—plants that may have descended vegetatively from a single apogamous spore.

I believe it is generally true that ferns in a favorable environment reproduce primarily by vegetative means, in spite of the millions of spores a single fern can produce. Spores enable dispersal and provide genetic diversity, enabling a species to colonize new habitats. But once established in that new habitat, the need to reproduce numbers of genetically identical individuals to saturate the environmental niche is best met by vegetative reproduction. In *Polypodium*, this is achieved mostly by rhizomes, which branch and bud off new plants. In other species, vegetative reproduction is by bulbils, essentially buds that may appear on stems or leaves. Apogamous spores, being larger, do not travel as far as the typical windborne spores. But they do seem to provide some genetic variability, which is usually achieved by sexual reproduction. Although variability is not as great, the fern is already in a favorable environment. It appears that direct production of the haploid sporophyte from spores provides the necessary variability without the need for the formation and fusion of gametes typical of normal sexual reproduction.

It is somewhat puzzling that apogamous spores can produce such variable offspring. It therefore seemed desirable to check that the spores produced by the population of *P. glycyrrhiza* in the Oak Knoll were actually apogamous and not the result of sexual reproduction. So I looked under the microscope at spores and sporangia taken from the Oak Knoll in December 2012. I found 16 large spores per sporangium instead of the typical 64 produced by meiosis (cell division that halves the chromosome number). My observation seemed to confirm that the spores were apogamous and that the variability in the resulting plants could not be attributed to sexual reproduction. So the puzzle remains.

P. scouleri

As well as the two closely related species of *Polypodium* described above, there are other species in this genus, such as *P. scouleri*, the leather fern. This fern is said to be restricted to the coast, where it can be seen at its best in the Gerdemann Botanical Preserve in Yachats. It can also be found in Hendricks Park and neighboring gardens along the park's Highland Avenue border.



Polystichum

This genus has fronds with bristle-topped teeth, and its round sori develop umbrella-like indusia.

P. acrostichoideste



(Left) The Christmas fern is the East Coast equivalent of the western sword fern. It does not grow well on the West Coast. It is found in the park near the rainbow bench and in few other places.

P. aculeatum

The hard shield fern is rare in this park. It will be considered in detail with *P. setifera*, with which it is often confused.

P. californicum

(Right) This fern was discovered and identified in the park only in June 2014. Just one specimen has been found.



P. imbricans

The narrow-leaved sword fern is smaller than the western sword fern and is almost devoid of scales on a shorter leaf stem. The fronds are narrower and smoother than those of *P. munitum*, and the pinnules overlap more. There is a specimen inside the bend in the path that parallels the junction of Skyline Blvd. with Birch Lane in the garden part of the park. In the garden, this species appears to have hybridized with *P. munitum*, acquiring a mixture of the two species' characteristics.



Polystichum imbricans, narrow-leaved sword fern

P. imbricans x munitum

Hybrids are found throughout the garden part of the park; they can be best identified by comparison with the western sword fern in the forested part of the park.

P. makinoii

This fern turns up in the bed surrounding the eastern water feature.

P. munitum, western sword fern



This evergreen, which is native to the Northwest, is the commonest fern in the park. Its fronds are very variable, as the pinnae may be long or short with toothed or smooth edges that can be wavy or straight. Crested varieties of this species are known, but they have not been seen in the park.

P. munitum 'crispa'

The crisped or curly edged western sword fern is the only variety seen that corresponds to a known cultivar of the western sword fern. The image below shows the most extreme crispa form in the park.





While many sword ferns have wavy edges, two individual plants in the park are acutely curled. One of these is hidden in a flower bed, while the other is on the steep path on the garden's SW boundary. This acute crisper form seems quite rare—I have not seen further examples after looking at many hundreds of sword ferns in the forested part of the park. However, there is one along the path that is open to the public through the private Gerdemann Botanic Preserve in Yachats on the Oregon coast.

P. neolobatum

The long-eared holly fern is glossy with 2-foot fronds. This evergreen is scattered throughout the park.

P. polyblepharum



The Japanese tassel fern also has 2-foot fronds, is evergreen, and is found throughout the park. The mature pinnules of this fern have several bristles.

***P. setiferum*, the soft shield fern, and *P. aculeatum*, the hard-shield fern**

These two ferns will be treated together because they are so difficult to tell apart. They are also said to



produce sterile hybrids with intermediate characters. Given the close similarity of the two species, that is not hard to visualize. A hybrid might have rudimentary or non-functional sporangia. The hard shield fern is said to do poorly in the NW. It requires more calcium in the soil than is present in the garden, but several of these ferns are apparently growing quite well, albeit slowly. Cultivars

formerly thought to belong to this species are now attributed to *P. setiferum*. The following table shows characteristics that are used to differentiate the two species, though the two ferns are very variable, and the criteria for distinguishing them are not infallible.

Above: *Polystichum aculeatum*

Right: *Polystichum setiferum*



P. aculeatum

P. setiferum

Spores	Dark brown	Yellow-brown
Stipe	Shorter (< 1/6 of frond length)	Longer (> 1/6 of frond length)
Pinnae	Basal pinnae about 50% of longest pinnae	Longer nearly equal to longest
Pinnules	Sessile to stalked	Stalked
Texture of fronds	Bristles feel coarse	Softer feel
Color of fronds*	Darker green	Green



*This color (colour!) difference is stressed by English authors, but I find it inconsistent in ferns grown in the U.S., where the fronds of both species seem to me to be a similar green. In the garden, most of these ferns are cultivars of *P. setifera*. Although the native European forms of both species can be found, they are relatively rare.

P. setiferum cultivars

Hundreds of cultivars of this species were described in the U.K. during the nineteenth century. We have very few of them in the garden, but they include some of the best:

P. setiferum 'Congesta' and *P. setiferum* 'Congesta Cristata'



These two dwarf cultivars were created by shortening the rachis, which crowds or congests the pinnae. They can be seen in bed #7.



7

P. setiferum 'Divisilobum' and *P. setiferum* 'Divisilobum Cristata'

These two cultivars can also be found in bed #7. The horticultural trade often misnames this cultivar as Alaskan fern. The reduced pinnules give a skeleton-like appearance to the fronds, which can be quite large and tend to spread horizontally.



Where the rachis comes into contact with the soil, buds may develop. This is a common means of vegetative reproduction in this genus.

P. setiferum 'Grandiceps'

To my mind, this is a very grand cultivar. Several specimens occur in the bed containing the garden's western water feature. The cultivar has long narrow fronds ending in a crested burst of short branches. There is an additional plant at the south end of bed #7. For a long time, I believed this to be a cultivar of *P. aculeatum*, but modern fern biologists seem to agree that essentially all the old English cultivars



belong to *P. setifera*. If this finding holds up, this will be yet another example of how the variability of a fern species is so great that it can overlap in form with other species.

P. setiferum 'Grandiceps'
another view



P. setiferum 'Plumoso-Divisilobum' or perhaps 'Plumoso-Multilobum'

'Plumoso' refers to the feathery appearance created by the overlapping pinnae and pinnules. In *multilobum*, the fronds are divided up even more than in *divisilobum*. To my mind, this is the most attractive of all the nineteenth-century fern cultivars. The ferns in the park are a dwarf form of this cultivar. A small group can be seen at the north end of bed #9. They appear to be sterile, and have presumably reproduced by vegetative means, probably by budding. The largest specimen is only a few inches high and less than a foot across, and it has not changed substantially in the past 12 years. Unfortunately, it was quite badly infested with a fungal disease caused by *Taphrina wettsteiniana* in 2010. This resulted in browning of the fronds. This fungus seems to be restricted in its host to the genus *Polystichum*. It is spread by spores in splashes of rainwater, which makes it hard to control in this climate. The disease was controlled by extensive pruning during the following growing seasons.



P. tsus-simense

The Korean rock fern is 2-feet tall, with dark contrasting veins. This fern is rare in the park but common in surrounding gardens.



Pteridium

This genus has deep rhizomes that give rise to single branched stems at intervals. The sori are marginal, and the indusium forms from the curled-up edge of the leaflet.

P. aquilinum var. pubescens, bracken

This deciduous fern, which is native to the Pacific NW, is an aggressive, weedy species. The rhizome, which can be 5 feet beneath the surface, sends up isolated leaf stalks at irregular intervals, and the long stems typically branch (see photograph on right). Bracken's large triangular leaves are bi-pinnate or tri-pinnate. This western variety is hairy on the underside. It can grow very tall (18 ft.), but is usually blown over in the park when it exceeds 10 ft. A group of *Pteridium* is located in the northernmost part of the park, just to the south of the path close to the junction with Birch Lane. If you enter the park from the north along Birch, these ferns are on the first trail on the right. Just a few feet inside the park's boundary, you will find bracken along with a few lady ferns on your left. Individual specimens are also scattered throughout the garden and forest.



The photograph on the left shows the underside of part of a frond with the curled-up margins to the pinnules. These precede the formation of the sori for which they will form the protective indusium. The thick curled-up margin extends around the curved apex to the pinnules, a feature that is unique to this genus of ferns.

Pyrrrosia

The felt ferns are characterized by a coating of silvery hairs on the underside of the fronds. The fronds are leathery, lanceolate and, superficially, very unlike those of ferns.



P. lingua

The tongue fern has leaves shaped somewhat like a pointed tongue. It is often sold in hanging baskets, as a tropical fern for indoor use. Somewhat surprisingly, it grows quite well outside in Eugene, as do a number of other ferns that also come from Japan. In 2013, there were several specimens scattered along Highland Avenue, on the park's southern boundary. Since the exceptionally cold spell of December/January 2013/14, I have not seen a single one in the park. It might just be a matter of time before they are found there again. This species is the only fern ever stolen from my yard.

Selaginella

The spike mosses are more primitive than the true ferns. These moss- or fern-like plants can be found in the park as epiphytes or on or near rocks. Each leaf has a single vein that may end in a hair or bristle. Sporangia are located in the axils of modified leaves in four rows or in spirals.



Pictured left are three unidentified species of *Selaginella* growing in my garden.

S. douglasii

This *Selaginella* has four rows of leaves: two lateral and two medial. It is found at rock bases in the forest. The sporangia form four-sided cones.

S. oregona

This plant has a single spiral of very small lanceolate leaves around stems that typically hang down from branches like green threads, giving a characteristic appearance to Oregon rainforests. In Hendricks Park, this species does not appear to be present at all times, possibly because Eugene may be close to its eastern limit. In 2011 and 2012, I saw it growing on maples near the old drinking fountain, but I have not seen any specimens since.

Woodwardia

The chain ferns are named from the lines of elongate sori on the underside of the frond. The sori are parallel to and on either side of the mid veins of the pinnules. They are said to look like the links of a chain or, more accurately to my mind, like rows of sewn chain stitches.



Three species of chain ferns can be found in Hendricks Park. Only one of them, *Woodwardia fimbriata*, is native.

W. fimbriata

Giant chain fern

This evergreen is native to the NW. You can find a specimen on the left side of the giant steps. This fern has the potential to be one of the largest ferns in the park. It can grow to 10 feet.

The underside of the frond is smooth. The frond has pinnae that become progressively larger from the tip to the base. The basal pair of pinnae are the longest.



W. radicans, European chain fern

This evergreen has bulbils on the underside near the ends of the fronds. As the fronds arch over to the ground, the bulbils root and create new plants. The basal pinna is equal to or slightly shorter than the one immediately above it. There are several specimens of *W. radicans* on the left side of the giant steps.



W. unigemmata

The third species in the park has red foliage in the spring that changes to green when the plant matures. This Asian species is said to be semi-evergreen, but in the park it is mostly evergreen, as the photo shows, because the green fronds of the previous year show clearly as the pink new growth occurs. The basal pinnae are the largest, as with *W. fimbriata*.

The bulbils can be multicolored, justifying the “gemma” (gem-like) part of the specific name. The “uni” part is less appropriate, as there may be more than one bulbil per frond. *W. unigemmata* was common in the park in 2010. Since that time, it has become rather rare because it has been replaced by *W. radicans*.

Dedication and Acknowledgments

Centuries ago, it was important to dedicate a book to an author's patron, and many pages were written extolling the patron's virtues. I like to think that Queen Victoria perhaps contributed to that custom's end by expressing her enthusiasm for the work of Lewis Carroll and letting him know that she would be willing to act as a patron and have him dedicate his next book to Her Royal Majesty. Perhaps anticipating a sequel to "Alice's Adventures in Wonderland," she must have been surprised to find Carroll's dedication in a book of mathematics, for Carroll was an Oxford don.

Nowadays, in academic circles, this dedication function has largely been taken over by a note of acknowledgement to granting agencies for support. In the past, my biological work was supported by national granting agencies in the U.K. (e.g., DSIR) and U.S. (NSF and NIH), by the various universities at which I worked, by private foundations (e.g., the Bob and Bessie Welder Wildlife Foundation) and even by a sporting event (the Deep Sea Roundup of Port Aransas, Texas), but this checklist required no funding and therefore needs no financial acknowledgements. I must, however, acknowledge the encouragement provided to me by the supportive staff of Hendricks Park, especially Emily Aune and Keith Stanley, and by the Tuesday morning volunteers under the leadership of Mieko Aoki, who, at a critical stage in the preparation of the manuscript, provided a few hours of typing just when it seemed that my Parkinson's disease might prevent this manuscript from ever being finished. I also acknowledge Jack Meacham's help with proofreading the introduction. His comments made this section much more readable.

Dedications have also declined to little more than a note thanking an author's mentor or spouse and occasionally (with a too frequent attempt at wit) the author's children without whose help the work would have been finished earlier and be already out-of-date. But my children are long grown and were always an inspiration rather than a distraction. So I thought I might dedicate this work to all of the people in Eugene who made our move to Oregon the best of the many moves I have made since my first from Torquay to Paignton, Devonshire, England in 1935. But when I started to list names, I realized there was one who really mattered to me above the hundreds of others. And so:

I dedicate this, as with all my work, to Linda who, when asked in Salisbury Hall, Leicester, England, one cold damp January evening nearly 50 years ago, said Yes and made everything that has happened since possible.

Martin Sage

The Ferns of Hendricks Park

<i>Adiantum</i>	21	<p><i>A. aleuticum</i>, western maidenhair fern <i>A. pedatum</i>, northern or five finger maidenhair fern <i>A. venustum</i>, Himalayan maidenhair fern</p>
<i>Asplenium</i>	24	<p><i>A. trichomanes trichomanes</i>, maidenhair spleenwort</p>
<i>Athyrium</i>	26	<p><i>A. filix-femina filix-femina</i>, common lady fern <i>A. filix-femina filix-femina 'Frizelliae'</i>, the tatting fern <i>A. filix-femina cyclosorum</i>, subarctic fern <i>A. filix-femina angstum</i> 'lady in red', a cultivar of the northern (American) lady fern <i>A. niponicum pictum</i>, Japanese painted fern <i>A. otophorum</i>, eared lady fern</p>
<i>Azolla</i>	32	<p><i>A. mexicana</i>, mosquito fern</p>
<i>Blechnum</i>	33	<p><i>B. penna marina</i>, alpine water fern or miniature deer fern <i>B. spicant</i>, deer fern</p>
<i>Cheilanthes</i>	35	<p><i>C. lanosa</i>, hairy lip fern</p>
<i>Cyrtomium</i>	36	<p><i>C. falcatum</i>, Japanese holly fern <i>C. fortuneii var. intermedium</i>, Fortune's holly fern <i>C. hybrid</i></p>
<i>Cystopteris</i>	38	<p><i>C. fragilis</i>, fragile fern</p>
<i>Dryopteris</i>	39	<p><i>D. affinis</i>, golden scaled male fern <i>D. arguta</i>, coastal wood fern <i>D. carthusiana</i>, spiny wood fern <i>D. crassirhizoma</i> <i>D. cystolepidota (D. nipponensis)</i> <i>D. cycadina</i>, shaggy wood fern <i>D. dickinsii</i> <i>D. dilatata</i> <i>D. dilatata 'recurvata'</i>, recurved form <i>D. erythrosora</i>, autumn fern <i>D. erythrosora 'prolifera' (D. bisettiana, D. varia)</i>, beaded fern <i>D. lepidopoda</i>, sunset fern <i>D. wallichiana</i>, Wallich's fern <i>D. species unknown.</i></p>

<i>Equisetum</i>	53	<i>E. arvense</i> , common meadow horsetail <i>E. fluviatile</i> , water or swamp horsetail <i>E. palustre</i> , marsh horsetail <i>E. hybrid</i> .
<i>Gymnocarpium</i>	56	<i>G. dryopteris</i> , oak fern
<i>Isoetes</i>	58	<i>I. nuttallii</i> , Nuttall's quillwort
<i>Lycopodium</i>	59	<i>L. clavatum</i>
<i>Matteuccia</i>	61	<i>M. struthiopteris</i> .
<i>Onoclea</i>	64	<i>O. sensibilis</i>
<i>Osmunda</i>	65	<i>O. regalis</i>
<i>Pellaea</i>	67	<i>P. falcate</i> , cliff brake <i>P. rotundifolia</i> , button fern <i>P. wrightiana</i> , Wright's brake
<i>Phyllitis</i>	69	<i>P. scolopendrium scolopendrium 'undulatum'</i> , hart's tongue fern
<i>Pityrogramma</i>	70	<i>P. triangularis</i> , gold-back fern
<i>Polypodium</i>	71	<i>P. calirhyza</i> , Californian polyploidy <i>P. glycyrrhiza</i> , licorice fern <i>P. glycyrrhiza 'longicaudatum'</i> , long tailed licorice fern <i>P. scolopendrium</i> , leather fern
<i>Polystichum</i>	76	<i>P. acrostichoides</i> , Christmas fern <i>P. aculeatum</i> , hard shield fern <i>P. californicum</i> , Californian sword fern <i>P. imbricans</i> , narrow leaved sword fern <i>P. imbricans x munitum</i> hybrid <i>P. makinoi</i> , Makino's holly fern <i>P. munitum</i> , western sword fern <i>P. munitum 'crispa'</i> , crispa cultivar of the western sword fern <i>P. neolobatum</i> , long eared holly fern <i>P. polyblepharum</i> , tassel fern <i>P. setiferum</i> , soft shield fern <i>P. setiferum 'congesta'</i> <i>P. setiferum 'congesta cristata'</i> <i>P. setiferum 'divisilobum'</i> <i>P. setiferum 'divisilobum cristata'</i>

		<i>P. setiferum</i> 'grandiceps'
		<i>P. setiferum</i> 'plumoso-multilobum'
		<i>P. tsus-simense</i> , Korean rock fern
Pteridium	87	<i>P. aquilinum</i> var. <i>pubescen</i> , bracken
Pyrrrosia	88	<i>P. lingua</i> , tongue fern
Selaginella	89	<i>S. douglasii</i> , Douglas's spike moss <i>S. oregona</i> , Oregon spike moss
Woodwardia	90	<i>W. fimbriata</i> , giant chain fern <i>W. radicans</i> , European chain fern <i>W. unigemmata</i>

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