

A woman with dark hair, wearing a red sleeveless top, is smiling and looking towards the camera. She is standing in a dense forest of ferns. Her right arm is extended, touching a large fern frond. The ferns are lush green and fill the background and foreground. The lighting is soft, highlighting the texture of the fern leaves.

ferns of

the Sierra



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ferns of the sierra

ROBERT J. RODIN, PH.D.

*Assistant Professor
Biological Sciences Department
California State Polytechnic College
San Luis Obispo*

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Yosemite Natural History Association
Yosemite National Park, California

CONTENTS

	<i>Page</i>
List of Illustrations	45
Introduction	47
The Story of Ferns	49
Glossary	53
The Fern Allies	57
Identification of the Ferns and Their Allies	60
References	120
Index	122

ILLUSTRATIONS

<i>Figure</i>		<i>Page</i>
Cover	Giant Chain Fern, <i>Woodwardia fimbriata</i> , taller than the author's wife, Elva Rodin	Cover
1	Fossil Fern	50
2	Life History of a Fern	51
3	Fossil Fern	54
4	Fern Sori (glossary)	55
5	Fern Fronds (glossary)	56
6	Carboniferous Forest Reconstructed	59
7	Fossil of Ancient Horsetail, <i>Annularia</i>	61
8	Little Grape Fern, <i>Botrychium simplex</i>	63
9	Leathery Grape Fern, <i>Botrychium multifidum</i> var. <i>coulteri</i>	65
10	Five Finger Fern, <i>Adiantum pedatum</i>	66
11	Five Finger Fern, <i>Adiantum pedatum</i> , and Common Maiden Hair Fern, <i>Adiantum capillus-veneris</i>	67
12	California Maiden Hair Fern, <i>Adiantum jordanii</i>	69
13	Lady Fern, <i>Athyrium filix-femina</i>	71
14	Alpine Lady Fern, <i>Athyrium alpestre</i> var. <i>americanum</i>	72
15	California Lace Fern, <i>Cheilanthes californica</i>	73
16	Indian's Dream, <i>Cheilanthes siliquosa</i>	74
17	Cooper Fern, <i>Cheilanthes cooperae</i>	75
18	Bead Fern, <i>Cheilanthes covillei</i>	76
19	Bead Fern, <i>Cheilanthes covillei</i>	77
20	Lace Fern, <i>Cheilanthes gracillima</i>	78
21	Lace Fern, <i>Cheilanthes gracillima</i>	79
22	Parsley Fern, <i>Cryptogramma crispa</i> var. <i>acrosticoides</i>	80

23	Parsley Fern, <i>Cryptogramma crispa</i> var. <i>acrostichoides</i>	81
24	Fragile Fern, <i>Cystopteris fragilis</i>	82
25	California Wood Fern, <i>Dryopteris arguta</i>	84
26	California Wood Fern, <i>Dryopteris arguta</i>	85
27	Coffee Fern, <i>Pellaea andromedaefolia</i>	87
28	Sierra Cliff Brake, <i>Pellaea brachyptera</i>	88
29	Brewer's Cliff Brake, <i>Pellaea breweri</i>	89
30	Bridges' Cliff Brake, <i>Pellaea bridgesii</i>	90
31	Bird's Foot Fern, <i>Pellaea mucronata</i> var. <i>mucronata</i>	91
32	Bird's Foot Fern, <i>Pellaea mucronata</i> var. <i>mucronata</i>	93
33	Desert Cliff Brake, <i>Pellaea mucronata</i> var. <i>californica</i>	94
34	Gold Fern, <i>Pityrogramma triangularis</i>	95
35	White Fern, <i>Pityrogramma triangularis</i> var. <i>pallida</i>	96
36	White Fern, <i>Pityrogramma triangularis</i> var. <i>pallida</i>	97
37	Licorice Fern, <i>Polypodium vulgare</i> var. <i>kaulfussii</i>	98
38	Golden Polypody, <i>Polypodium vulgare</i> var. <i>columbianum</i>	99
39	Golden Polypody, <i>Polypodium vulgare</i> var. <i>columbianum</i>	100
40	Sword Fern, <i>Polystichum munitum</i> , and two forms	101
41	Sword Fern, <i>Polystichum munitum</i> , and Nude Sword Fern, form <i>nudatum</i>	102
42	Imbricated Sword Fern, <i>Polystichum munitum</i> , form <i>imbricans</i>	103
43	Brake Fern, <i>Pteridium aquilinum</i> var. <i>pubescens</i>	104
44	Rocky Mountain Woodsia, <i>Woodsia scopulina</i>	105
45	Rocky Mountain Woodsia, <i>Woodsia scopulina</i>	106
46	Oregon Woodsia, <i>Woodsia oregana</i>	107
47	Giant Chain Fern, <i>Woodwardia fimbriata</i>	108
48	Duckweed Fern, <i>Azolla filiculoides</i>	110
49	Common Horsetail, <i>Equisetum arvense</i> , and Common Scouring Rush, <i>E. hiemale</i> var. <i>californicum</i>	111
50	Common Horsetail, <i>Equisetum arvense</i>	112
51	Common Scouring Rush, <i>Equisetum hiemale</i> , and Smooth Scouring Rush, <i>Equisetum laevigatum</i>	113
52	Kansas Scouring Rush, <i>Equisetum kansanum</i>	114
53	Hansen's Selaginella, <i>Selaginella hansenii</i> , and Alpine Selaginella, <i>Selaginella watsonii</i>	116
54	Bolander's Quillwort, <i>Isoetes bolanderi</i>	118
55	Nuttall's Quillwort, <i>Isoetes nuttallii</i> , and Bolander's Quillwort, <i>Isoetes bolanderi</i>	119

INTRODUCTION

Probably no group of plants is so greatly admired and so little known as our ferns and their allies. Many people have been attracted to ferns by their grace and beauty but have failed to continue their interest when a wall of technical terms appeared to block their way. In this do-it-yourself age the purpose of this book is to help the amateur as well as the trained botanist to gain a better understanding of this group of plants in the Sierra Nevada. Although the main purpose of this book is the identification of these plants, it is hoped that the additional material will show ferns are sometimes useful and decorative.

Identification of ferns is not a difficult task. Ferns are much easier to identify than the more numerous flowers and trees in our area. There are only about 35 ferns in the Sierra Nevada and about 75 in the Pacific States, according to Abrams (see references). The terms used for the identification of ferns are somewhat different than the terms used for most flowering plants. With a few new words one can master the identification of most ferns found in an afternoon's outing. Of course, with the aid of illustrations the key can almost be ignored. If an illustration appears identical to a fresh specimen one is identifying, always confirm the species by reading the description near the photograph.

There is disagreement among botanists regarding the scientific names of many ferns. Although plant names are based on priorities, the final priorities have in some cases not yet been decided. The name believed by this author to have priority is the scientific name given here. Synonyms sometimes preferred by other botanists are indicated below the scientific names. It should be recognized that common names vary from one locality to another, but the most commonly used name is the one given.

Do you have any native ferns in your garden? Many amateur gardeners are finding that the beauty of ferns can be taken into their gardens, sometimes to fill a cool, shady corner, sometimes in the crevices of a rock garden, for ferns have a variety of habitats. The culture of ferns is not difficult. Although some ferns do poorly in gardens, and the rock ferns in dried habitats are not green and fresh during the dry summer months, many ferns grow easily with a minimum of care. The Giant Chain Fern (*Woodwardia*), the Sword Fern (*Polystichum*) and various species of Maiden Hair and Five Finger Ferns (*Adiantum*) are among the favorites which are commonly cultivated. Many native ferns are available in nurseries. They do best with yearly applications of leaf mold or peat moss, and, of course, most ferns require frequent watering after the rainy season.

May we insert a word of caution to the reader? In our National Parks, State Parks, and certain other areas **NO PLANTS ARE TO BE REMOVED**, as these areas would soon be devoid of their natural beauty. Soon nothing would remain but a barren landscape. Can you imagine what Yosemite National Park would look like if each of the 1,500,000 visitors this year were to pick one fern or flower? It would be a major catastrophe! Specimens should be collected elsewhere at least 100 yards from roads or trails, or obtained from your nursery.

An attempt has been made to include habitat and close-up photographs of as many species as possible. For background on all close-up photographs, ½ inch squares are used to show the scale.

A few species of ferns and their allies have not been collected or photographed by the author and are not included. Most of the field work has been conducted in Sequoia National Park, Yosemite National Park, the Sonora Pass area and adjacent foothills. Many of these ferns extend to the coastal parts of California, southward into Mexico, or northward into Washington. General information about distribution is given with each species.

The author wishes especially to thank Douglass Hubbard, Park Naturalist, Yosemite National Park, and his staff for their assistance and for use of facilities during several summers which has made this project possible. Help was received from Harry Robinson, Park Naturalist, and Richard Burns, Assistant Park Naturalist, Sequoia National Park. Richard G. Prasil, Park Naturalist, Lassen Volcanic National Park, provided a list of ferns known from Lassen Park. Paul F. McCrary of Yosemite National Park helped with editing.

Ideas contained herein have come from Jepson's *Manual of the Flowering Plants of California*, Abram's *Illustrated Flora of the Pacific States*, and Frye's *Ferns of the Northwest*. Broun's *Index of North American Ferns* was the authority for many of the synonyms and common names as well as total distribution of a species. As early as 1939 the author spent time in the Sierra collecting plants, including many ferns. In the spring of 1946 enroute to a ranger naturalist position in Yosemite for the summer, he was given a copy of *A Yosemite Flora* by Mrs. Carlotta Hall, one of the authors. Enclosed in the book were notes written by her to bring the fern information up-to-date. That book has been carried on many trails in the park and much of the information given by her is incorporated here.

The help of Rolla Tryon, Curator of Ferns at Gray Herbarium, Harvard University, and his wife, Alice Tryon, is gratefully acknowledged. The Tryons generously assisted in identifying ferns and reading the manuscript for correctness of fern classification. Thanks are due also to Herbert L. Mason, Director of the Herbarium, University of California at Berkeley, for his encouragement and the loan of herbarium specimens. Much help in locating specimens to photograph in the field was received from material in the Yosemite National Park Herbarium, especially ferns collected by Mrs. Enid Michael Benson and Carl Sharsmith. Fossils were photographed with the assistance of Michael McRae. Robert F. Hoover and Glenn Noble read the manuscript and made helpful suggestions.

The illustrations are original drawings or photographs by the author unless otherwise noted. Photographs were taken with a 4 by 5 inch Speed Graphic Camera. All background grids in this book are ½ inch squares.

THE STORY OF FERNS

Ferns differ from our cone bearing and flowering plants because ferns produce spores, but no flowers or seeds or other large specialized reproductive structures. Both groups, ferns and seed plants, have many features in common: Roots, stems, leaves, and a vascular system to conduct water, minerals and foods. Because flowers were absent the ferns and their allies were called *Cryptogams* (hidden reproduction) by early European botanists. Until recently, ferns and their allies usually have been included in the large category called *Pteridophytes*. Recently ferns have been included in the subphylum *Pteropsida*, along with seed plants.

In western America one thinks of ferns as common plants. The actual number of fern species is relatively few compared to the number in humid tropical regions where they occur in vast numbers and often in more specialized forms. Such specializations include very thin, delicate filmy ferns which must live in constant mist or spray, or noble tree ferns that attain great height. Only occasionally in temperate regions, but very commonly in tropical rain forests, do ferns live on trees, and thus are called *EPIPHYTES*. These epiphytes receive no nourishment from the living tree.

A mature fern plant consists of roots, a stem and *FRONDS* (leaves). The profusely branched root system serves to absorb mineral nutrients and water from the soil. The roots of some rock ferns, which live in very dry habitats, penetrate to great depths and in mysterious ways grow toward moisture. Our ferns may have short stems above ground, but more often have an elongated underground stem called a *RHIZOME*. The structural features of rhizomes, such as, size, degree of branching, length, and presence or absence of scales, are important in the identification of ferns. The green *FRONDS* of ferns serve not only to manufacture food for the plant, but to support the reproductive structures which produce dust-like asexual *SPORES* on the undersides of the leaves. The leaves may be quite simple but are often compounded in various ways (see illustrations p. 56).

Leaf and stem characters are used in identification of ferns, but more important is the arrangement of the spore-bearing structures on the underside of the leaf. *SPORES* are produced in large numbers in special organs called *SPORANGIA*. *SORI* in the form of dots or lines are formed from clusters of sporangia. Rarely a sorus may cover much of the undersurface of a frond. Sori may form around leaf margins and in such cases the leaf usually curls around the sorus to protect the young sporangia. Any protective cover over a sorus, whether it be a curled leaf margin, a flap of tissue, or perhaps a miniature umbrella, is called an *INDUSIUM* (See illustrations p. 55).

The story of a fern does not end here. What happens to the spores that are formed by the millions each year on a fern plant? It would be logical to propose that they grew into new fern plants. When moisture is present and temperatures are suitable, that is what they do — only not into the fern plant with which people are most familiar. This new fern plant is part of an alternating cycle that represents the sexual phase of this plant and is a required phase in the reproductive cycle. The spore develops into a small heart-shaped green plant called a *PROTHALLUS* (See illustrations p. 51). *RHIZOIDS*,

miniature root-like structures on the lower side absorb water from the soil. Among the rhizoids, numerous spherical male organs are formed called ANTHERIDIA which eventually produce myriads of motile SPERM that swim to the female organ. As many as 20 ARCHEGONIA, the female organs, may occur near the notch of the prothallus. Each archegonium contains one egg which remains in the archegonium during fertilization and afterward. The fertilized egg develops into the familiar fern generation, absorbing some nutrient from the small prothallus until it is large enough to manufacture its own food. Only one fern plant develops from a prothallus, and as we now see, the cycle of life and reproduction is completed. Thus a spore-bearing generation, the familiar fern plant, always alternates with a small sexual generation. There can be no short cut except in a few species where vegetative buds produced on the leaves provide an asexual new plant, much as garden plants are started by leaf or stem cuttings. The long underground stems or rhizomes might also be considered a vegetative method of reproduction because they promote the spreading of some species such as Brake Ferns.

Ancient forests contained ferns as far back as the Coal Age. A few ferns are known in the fossil record even before that time although the ferns were not the most ancient vascular plants.

Ferns related to our Grape Fern, *Botrychium*, in the Adder's Tongue Family, Ophioglossaceae, are probably the earliest ferns in history which are related to our living forms. There are some related groups now completely extinct of which the Seed Ferns or Pteridosperms are worthy of mention. These fern-like plants were more common in the Coal Age than true ferns. The illustrations (pp. 50, 54) of fossil ferns are examples of the evidence we have of these ancient plants. More details of their preservation are discussed in the next chapter. Even though ferns were perhaps not a dominant part of the floras making up coal, they contributed to its formation.

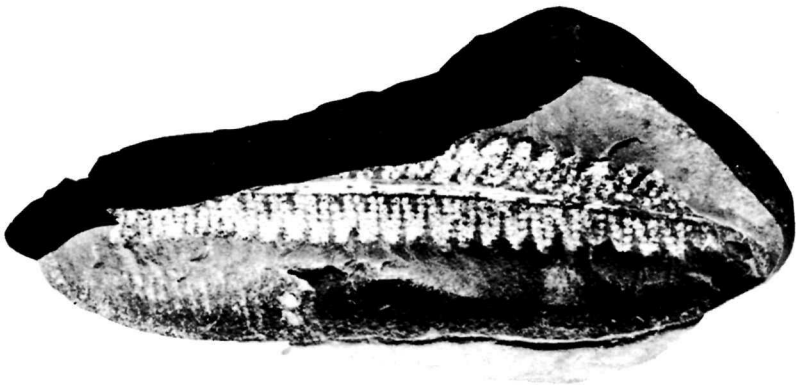
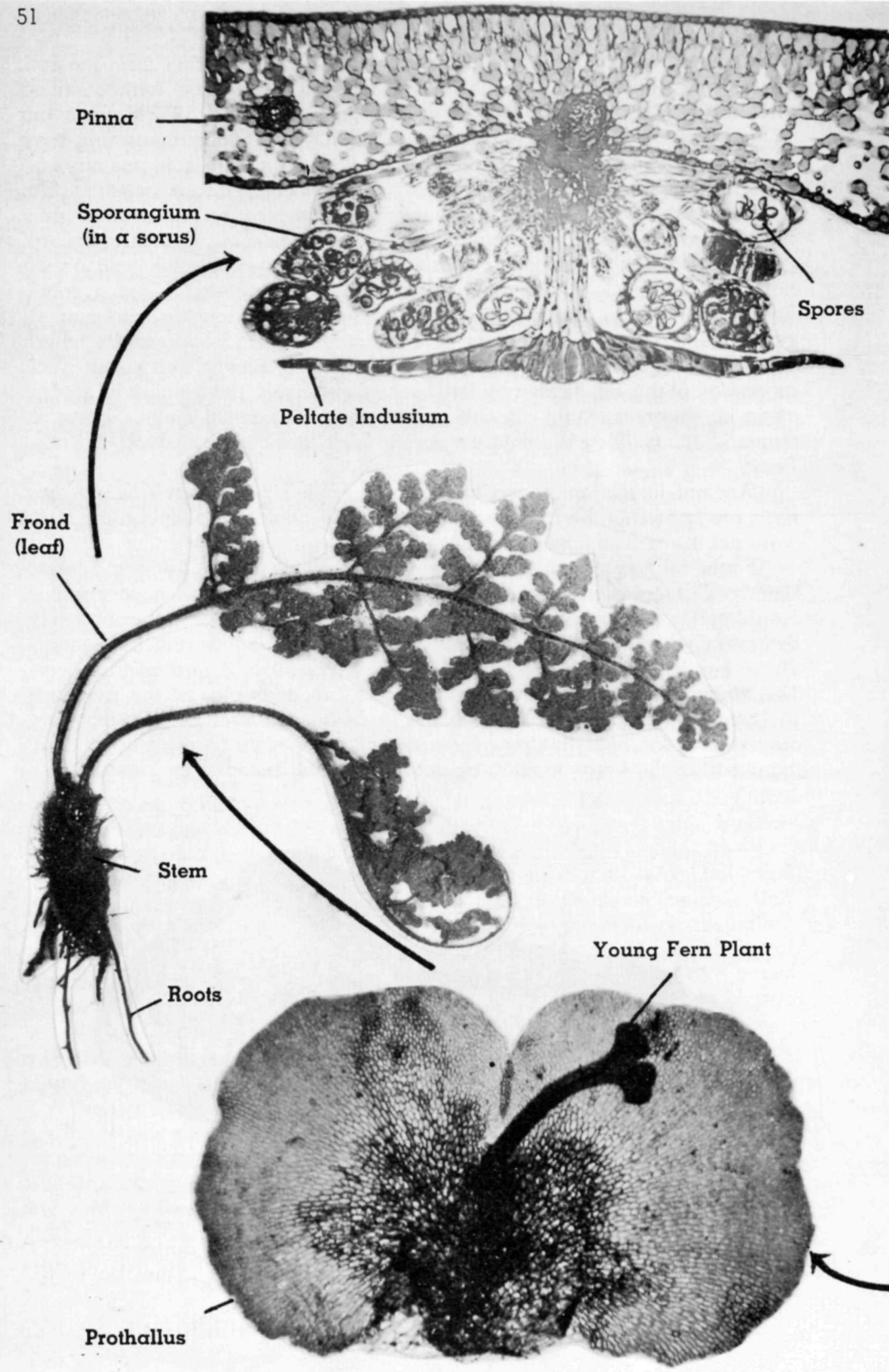


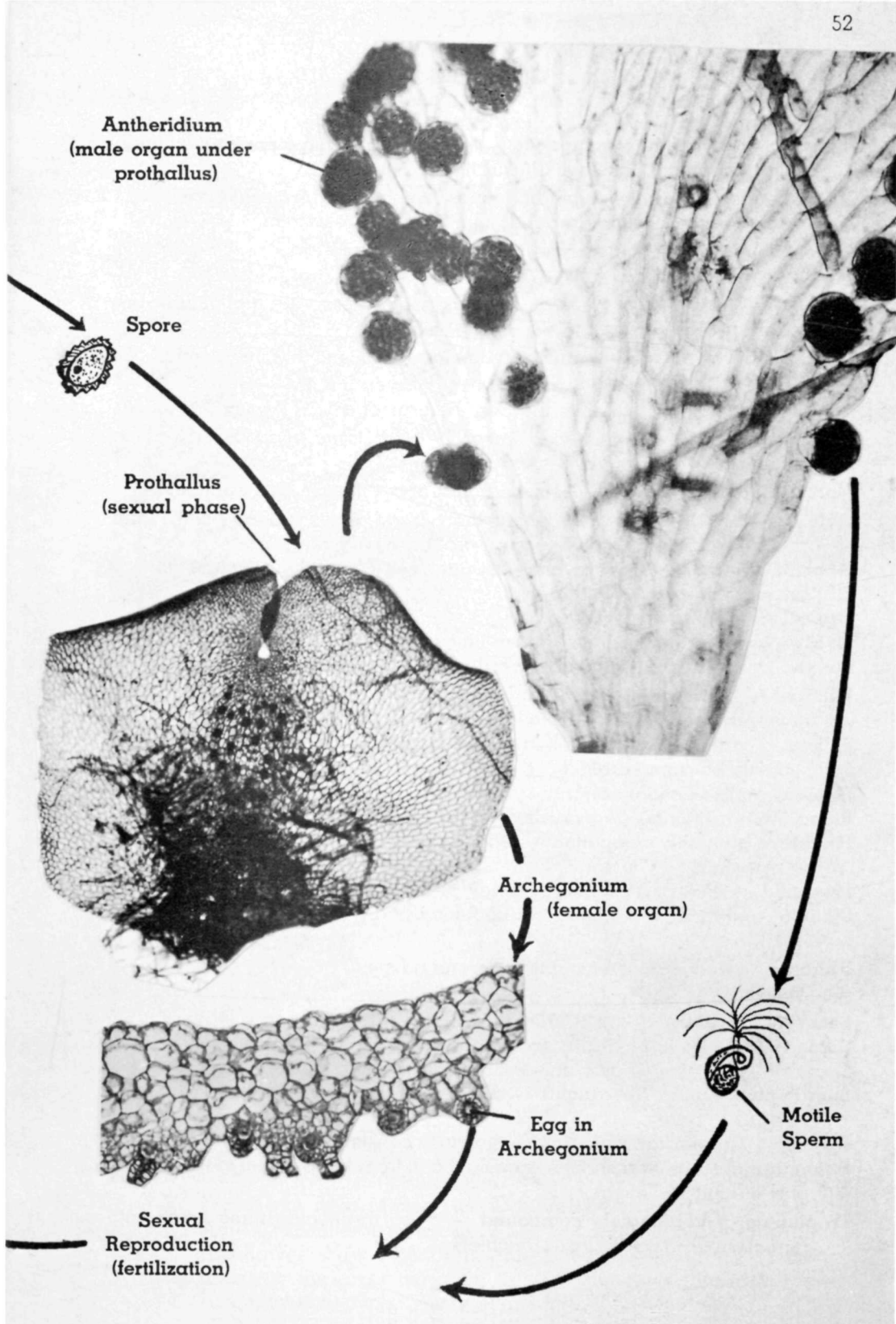
Fig. 1 Fossil fern from Mazon Creek, Illinois, with well preserved sori. This fern was living over 250 million years ago during the Coal Age (Carboniferous Period). Specimen courtesy of Ethel Doerer.

LIFE HISTORY OF A FERN

51



52



GLOSSARY

- Bi-pinnate** or **bi-pinnately compound** — twice pinnate with pinnules scattered along secondary branches (Illustration p. 56).
- Cilia** — hairs on margins of certain leaves, especially in *Selaginella*.
- Corm** — a condensed underground stem which stores food.
- Dichotomous** — a primitive type of branching which forks repeatedly into two equal branches.
- Elliptical** — from 3 to 4 times as long as wide, tapering equally from the center toward both ends.
- Fronde** — leaves of certain plants such as ferns and palms (Illustration p. 56).
- Imbricated** — overlapping of leaves, as shingles on a house.
- Indusium** — a protective covering over a sorus of a fern (Illustration p. 55).
- Lanceolate** — lance-shaped, widest near the base, tapering toward the apex.
- Linear** — a long narrow leaf.
- Marginal sori** — clusters of sporangia only at the margin of a pinnule.
- Oblong** — two or three times longer than broad, sides tapering somewhat from the middle, or sides nearly parallel; nearly rectangular.
- Obovate** — egg-shaped with broadest part away from the attachment.
- Obtuse** — rounded or blunt.
- Orbicular** — round or nearly so.
- Oval** — broadly elliptical, about two times as long as the width.
- Ovate** — egg-shaped, broadest toward the attachment.
- Palmate** — branches or leaflets of a leaf all borne at the apex of a common petiole, as all the fingers come from the palm of the hand.
- Peltate** — round, with a stalk attached on the underside at the middle; shaped like an umbrella.
- Petiole** — stalk of a leaf or frond.
- Pinna** (plural: **Pinnae**) — a primary leaflet of a compound leaf.
- Pinnate** or **pinnately compound** — leaflets along both sides of a single petiole or leaf stalk.
- Pinnatifid** — cleft in a pinnate manner, or deeply pinnately lobed.
- Pinnule** — the smallest leaflet of a bi-pinnately or more highly compounded leaf.
- Rhizome** — elongated, horizontal underground stem.
- Segment** — smallest division of a frond; pinnules.
- Seta** (plural: **Setae**) — a soft bristle found at the apex of some leaves.
- Sorus** (plural: **Sori**) — a cluster of sporangia on the underside of a fern, usually appearing as a dot or line, (illustration p. 55).
- Sporangium** (plural: **Sporangia**) — a reproductive organ producing asexual spores.
- Spores** — an asexual reproductive structure consisting of a single cell.
- Submarginal sorus** — a sorus somewhat back from but parallel to the margin of a pinnule.
- Tri-pinnate** or **tri-pinnately compound** — a leaf branching three times with pinnules borne on the last branchlets.

Did you see a reversal of this curling effect? This optical illusion is more obvious when one realizes that these are not two halves of one nodule, but two identical photographs facing opposite directions. Specimen courtesy of Frederick Essig.

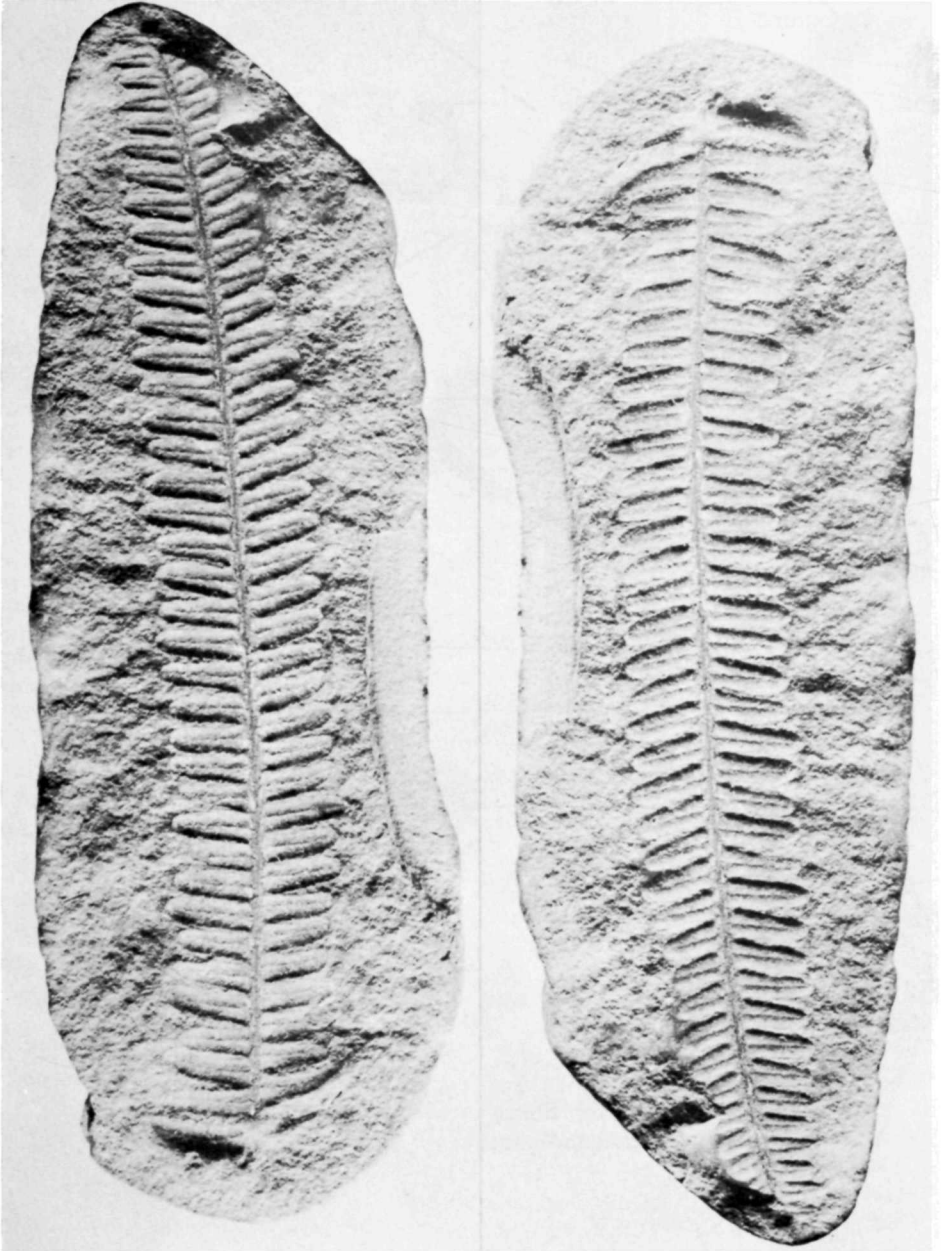
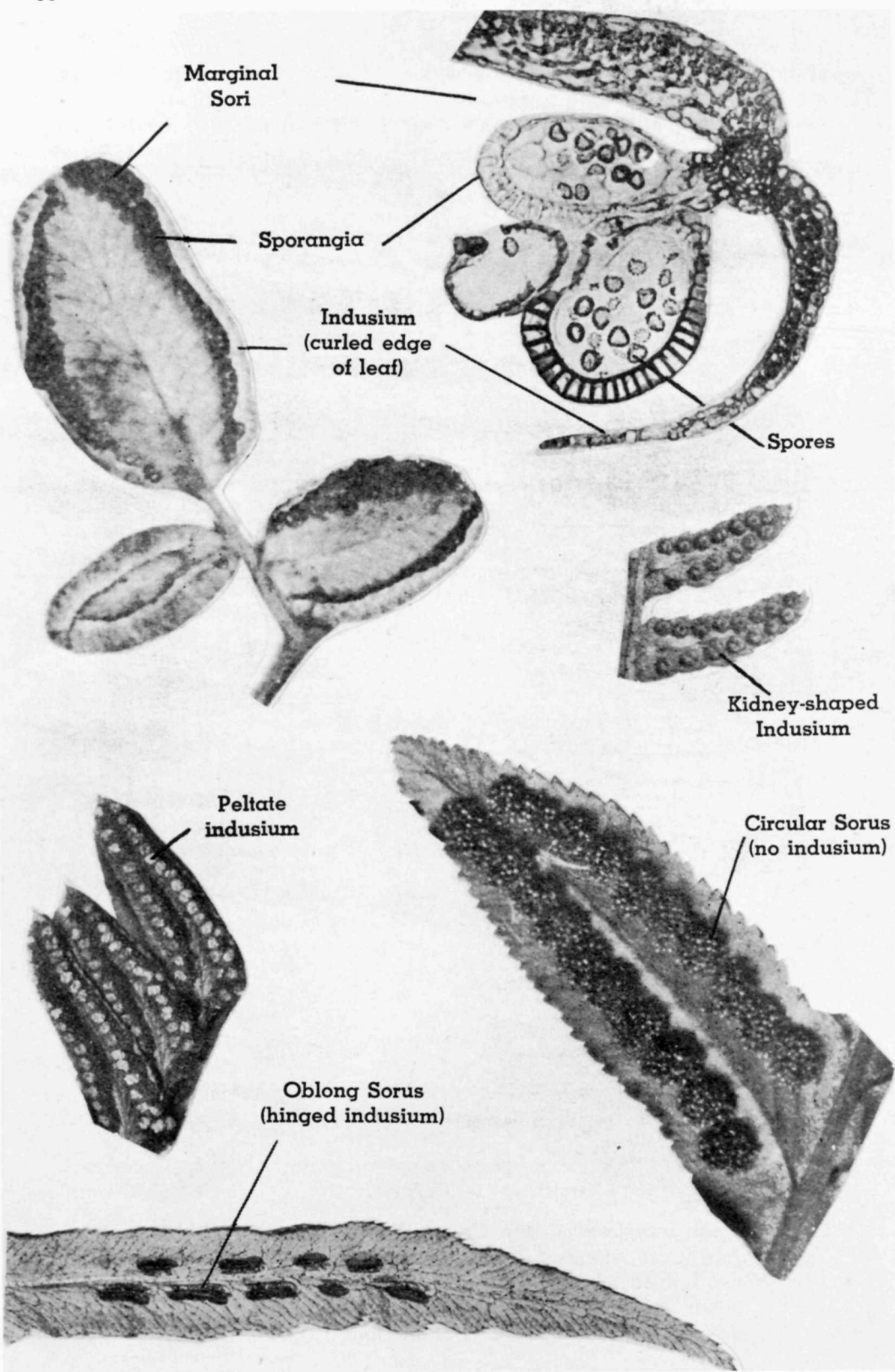


Fig. 3 Fossil fern from Mazon Creek, Illinois, that lived during the Coal Age (Carboniferous Period). When a nodule is broken in half, the two halves show on imprint. Note that in one frond the pinnae curl down, in the other they curl up. Now turn this illustration upside down, looking continuously at one fern.

FERN SORI



Marginal Sori

Sporangia

Indusium (curled edge of leaf)

Spores

Kidney-shaped Indusium

Peltate indusium

Circular Sorus (no indusium)

Oblong Sorus (hinged indusium)

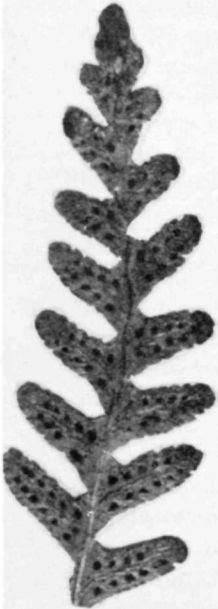
Pinnately compound



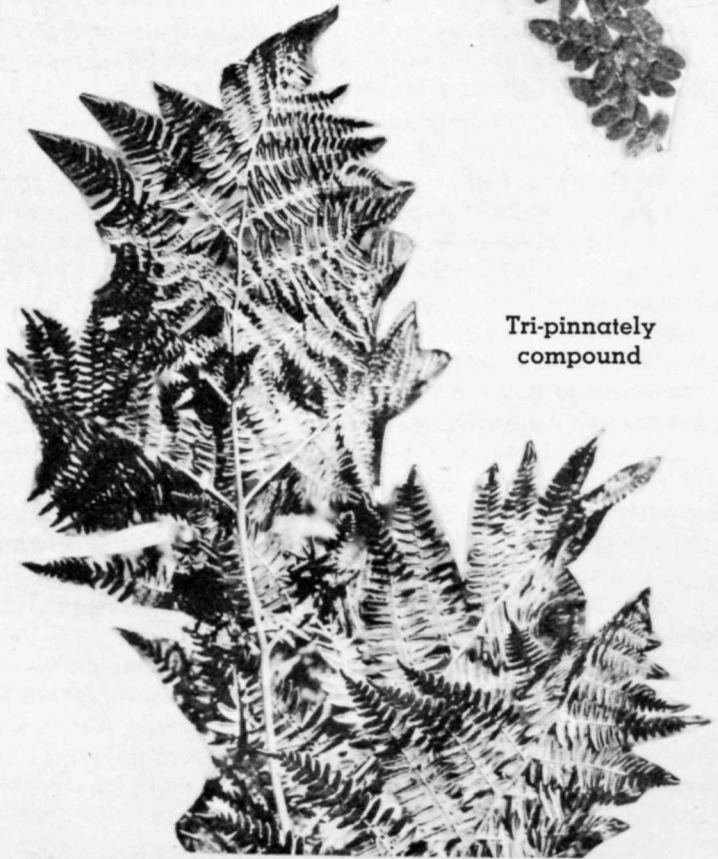
Bi-pinnately compound



Simple lobed leaf or frond (Pinnatifid)



Tri-pinnately compound



THE FERN ALLIES

If we could suddenly transport ourselves back to the Coal Age, or Carboniferous Period, as it is called by geologists, probably none of the plants in those magnificent rain forests would be familiar to us. Even the dinosaurs and other large reptiles feeding on them would seem strange, except to those who have visited museums to see the reconstructed plants and the animal skeletons. Yet these lush forests of trees 90 or 100 feet high and three feet in diameter were the progenitors of our present spore-bearing vascular plants, the ferns and their allies. These were the plants from which nearly all the coal we burn had its origin.

In the ensuing ages as the climate of the northern hemisphere became cooler and drier, many of these large spore bearing trees became extinct, and their extinction, in turn, may in part have been responsible for the extinction of the giant reptiles who fed upon them. Through all the struggles for existence, a few remnants of these plants survived and remain with us today.

All that we know about previously existing forests comes to us from various fossil evidence such as carbonization, imprints, petrifications, or casts. Coal represents carbonized plant material, but few structures are preserved to identify the plants in the coal. Odd structures called coalballs, found near coal formations, have furnished some of our best material for the study of plants known during the Coal Age. It is not known how coalballs formed. Leaves which fell into slow moving streams or lakes were covered with clay or sand and left permanent imprints showing the perfect outline and details such as vein patterns. These soil particles later became compacted to form shale or sandstone in which the fossils may be discovered today. Some stems, roots and cones have become petrified, meaning that most of all the organic material has been replaced gradually by dissolved mineral substances such as silicates or carbonates. Petrification is an extremely slow process that depends upon plants being kept free from fungi and bacteria which cause rotting. Plant structures which are to become petrified usually are covered by silt or volcanic ash and are thus protected from decay. Some trees which were covered by mud or volcanic ash did rot out. In the cavity, dissolved material seeped in. Thus a cast was made showing fine details of bark, leaf scars and other external features, but no internal structure was preserved.

Unfortunately, a complete plant consisting of stems, leaves and cones is never preserved in a single locality. Cones may be petrified in one area, stems somewhere else. Leaf imprints are never found with petrified stems. Stem casts are preserved under different circumstances.

Now let us examine briefly some of the major plant groups among the fern allies, most of which are native to California.

The earliest fern ally appeared about 300 million years ago and specimens of it are well preserved as petrified stems in chert of Rhynie, Scotland. These earliest plants did not even have leaves, just forking stems with a simple vascular system and 4 spores borne at the top of the stem. A living remnant of this oldest group, Psilopsida, is the genus *Psilotum*, not native to California, but to the tropical areas of the world.

The Club Mosses or Lycopsidea form a major group among the fern

allies with two of the four known genera growing in the Sierra Nevada. The living plants represent only a remnant of a large group once numbering hundreds of species. During the Coal Age many were large trees; our present species are mostly low growing erect or creeping plants. These plants have roots, stems and small leaves, usually spirally arranged. The SPORANGIA, clustered at the stem tips in CONES, are not attached to the stem, but to the top of the leaf, designated a SPOROPHYLL, or spore-bearing leaf. Some cones are borne on special stalks, others are difficult to distinguish from a vegetative branch.

Lycopodium, one genus not represented in the Sierra, but found further north, as well as in tropical areas, has HOMOSPORUS cones, in which all spores are the same size, similar to our common ferns. *Selaginella*, a genus in our area, is HETEROSPORUS, having two kinds of spores in each cone: MICROSPORES, very small ones, and MEGASPORES, larger ones. The third common genus is *Isoetes*, which always grows in damp places and is often submerged in lakes or quiet streams. *Isoetes* in no way resembles the other genera. It looks much like a sedge or grass with long slender leaves which have large air spaces inside. The stem of *Isoetes* is condensed into a storage tissue called a CORM. The outer leaves actually are MEGASPOROPHYLLS, each leaf bearing one sporangium with its numerous MEGASPORES at the base. The inner leaves are really MICROSPOROPHYLLS, each bearing one sporangium with thousands of MICROSPORES.

The life cycle of Club Mosses is similar to ferns with alternating spore-bearing and sexual generations. In those genera which are HETEROSPORUS the microspores form male plants, the MEGASPORES form female plants. These sexual plants are small and sometimes not green, often parasitic.

The extinct Club Mosses, which were present as trees and shrubs in the Carboniferous Period or Coal Age, became important components in Coal. One example of an extinct genus is *Lepidodendron*, meaning scale tree, a large tree with dichotomous branching stems and roots. Many casts and preservations of this tree show the leaf scars the whole length of the stem. Leaves of the Club Mosses were either scales or long and narrow.

The last major group is the Horsetails or Sphenopsida with a single living genus, *Equisetum*. Its 25 species are found in all parts of the world except Australia and New Zealand. The jointed hollow stems have a reduced whorl of leaves at every node, fused into a collar. Most of the photosynthesis occurs in the green stems. In some species the stems are unbranched, in others whorls of smaller jointed branches occur. The spores are borne in cones at the ends of the stems. Again in this group the alternating spore and sexual generations occur.

Among extinct Horsetails the whorls of leaves were not always fused into a collar as in living forms. In *Annularia* (illustrated p. 61) the wedge-shaped leaves are not fused to each other. Some of the extinct forms had a cambium which was the reason for much larger stems and roots than in our present forms.

Our living fern allies represent a remnant which was able to survive the severe climatic changes on this continent and in other parts of the world, and have adapted themselves to their present environments.



Fig. 6 Carboniferous forest composed of now extinct species of Horsetails, Club Mosses, Ferns, and related plants as reconstructed from fossils. Courtesy of Chicago Natural History Museum.

IDENTIFICATION OF THE FERNS AND THEIR ALLIES

KEY TO THE GENERA

	Page
I. Aquatic spore-bearing plants	
A. Attached grass-like in pond or on moist soil	117
B. Floating, small, leafy, branching plants	109
II. Terrestrial spore-bearing plants	
A. Sporangia borne in cones	
1. Creeping, leafy, moss-like plants, cones quadrangular in cross-section	114
2. Erect, jointed, rush-like, leafless except for collar-like sheath at nodes, cones round in cross-section	109
B. Sporangia borne in clusters on a special stalk from basal part of plant	62
C. Sporangia borne on underside of leaf in clusters called sori	
1. Indusium (cover over sporangia) absent	
Underside of fronds white or yellow with a powder	94
Underside of fronds without any powder	
Fronds deeply pinnately lobed or pinnately compound	96
Fronds bi- or tri-pinnately compound	70
2. Indusium present, sori marginal or on underside of leaf	
α. SORI MARGINAL, covered by curled leaf margin or marginal indusium	
(1) Stalks light or straw-colored, except at base	
Fronds of 2 kinds: Taller fertile and shorter sterile, plants less than 1 foot high	80
Fronds all alike, plants 1½ to 4 feet high	103
(2) Stalks dark-colored (except <i>Pellaea andromedaefolia</i> with tan to reddish stalks)	
Delicate pinnae, midrib or pinnae not evident veins nearly all the same size and forking; grow in damp, protected places	66
Thicker pinnae, (except <i>Pellaea breweri</i>) midrib on pinnae or lobes always visible, sori more or less continuous, in dry exposed places.	
Fronds and stalks scaly or woolly or both (except two species), indusia interrupted, or if continuous segments, bead-like	73
Fronds not scaly or woolly, indusium continu- ous, bearing sporangia on surface of pin- nae	86

	<i>Page</i>
b. SORI NOT MARGINAL, each covered with a special indusium	
(1) Sori round or kidney shaped, plants rarely over 2 feet high	
Indusium scale-like, attached to vein below sporangium, reflexed or somewhat deciduous in older fronds	<i>Cystopteris</i> 83
Indusium saucer or fringe-like, attached centrally to a stalk beneath the sporangia	<i>Woodsia</i> 105
Indusium shield-shaped, attached centrally above the sporangia	
Indusia orbicular without a sinus	<i>Polystichum</i> 100
Indusia kidney-shaped, or orbicular with a narrow sinus	<i>Dryopteris</i> 83
(2) Sori oblong or linear, tall ferns, usually over 2 feet high	
Sori in rows, parallel to midrib on lobes of pinnae	<i>Woodwardia</i> 107
Sori in rows, oblique to midrib of pinnules or lobes of pinnae	<i>Athyrium</i> 70

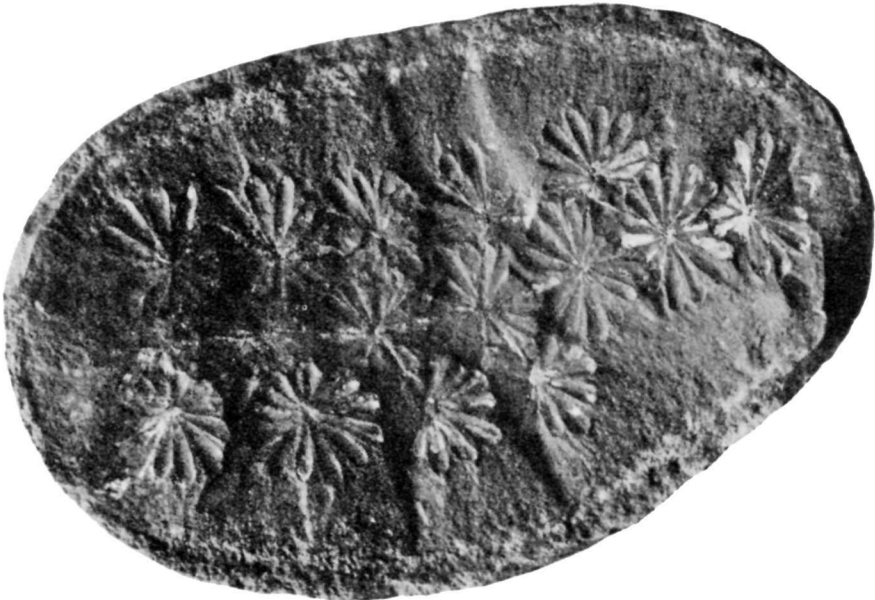


Fig. 7 Split nodule revealing a preserved extinct horsetail, *Annularia*, found in Mazon Creek flora of Illinois, from the Coal age (Carboniferous Period). Specimen courtesy of Ethyl Doerer.

OPHIOGLOSSASEAE

ADDER'S TONGUE FAMILY

This family with two principal genera is based on *Ophioglossum*, a genus not represented in the Sierra. Members of this family

usually produce one leaf per year, and a special stalk bearing large spherical sporangia are located laterally.

BOTRYCHIUM

Grape Fern Genus

Perennial plants arising from a fleshy or fibrous rootstock, usually bearing one leaf per year which dies down during the winter. Leaves simple or compound, dichotomously veined, never net-veined. Spores borne on a special stalk, sometimes arising at the leaf base, at other times from the leaf stalk, the clustered sporangia appearing very much like small bunches of green

grapes.

This genus, although appearing quite specialized because sporangia form on a stalk and not on the lower surface of the leaf, as in most ferns, is considered our most primitive genus of ferns. Most species of this genus are from temperate parts of the world. Within any one of our species there is great variation of leaf forms.

KEY TO THE SPECIES:

Plants 2 to 5 inches high: leaves simple to compound *B. simplex*
 Plants 12 to 18 inches high; leaves compound *B. multifidum*
 var. *coulteri*

LITTLE GRAPE FERN

***Botrychium simplex* E. Hitchc.** (Fig. 8)

Slender plants 2 to 5 inches high; leaves variable from simple, lobed, to pinnate, or with divisions from the base with pinnate subdivisions. Leaf segments may be obovate, obtuse, rounded or with blunt teeth or lobes. Sporangia borne on a stalk arising at base of the leaf, this stalk usually taller than the leaves, a simple or compound spike; the lateral small

green sporangia clustered near the apex. Spores are yellow.

This fern has also been known as the Simple Grape Fern. In the Sierra Nevada distributed from Tulare to Tuolumne counties at higher elevations. It is also known from Siskiyou County, north to Wyoming and British Columbia, east to Pennsylvania, New Jersey, and Newfoundland, and in Europe and Asia. Although herbarium specimens show it to be widespread, this small fern



Fig. 8 LITTLE GRAPE FERN (*Botrychium simplex*). Upper: Habitat among sedges and grasses in an alpine meadow about 10,500 feet elevation. Lower: Details of two whole plants.

is often overlooked. As found in our higher open meadows, it is no taller than the short grasses and sedges around it. The author has searched in many meadows in Yosemite for this particular fern. On one occasion in Miguel meadows, when the author was accompanied by Dr. Herbert L. Mason, who had collected this species at that place 20 years before, none could be found. *Botrychium*

simplex is now apparently extinct in that area. A contributing factor may be the corral for government horses located there at present. Credit must be given to my faithful wife who found the specimens shown in the accompanying illustrations while we were on a pack trip to the Mono Pass area, near Kuna Creek, at about 10,500 feet elevation. It was quite plentiful in that meadow.

LEATHERY GRAPE FERN

***Botrychium multifidum* var. *coulteri* (Underw.) Broun (Fig. 9)**

B. silaifolium as given by Jepson.

Plants 12 to 18 inches high, with deep rootstock. Commonly one leathery leaf with stalk mostly underground; leaf compound, ultimate segments ovate or obliquely oval, rounded or with blunt teeth. Two leaves or dying leaf from previous year sometimes present. Stalk bearing sporangia pinnately divided several times with large green spor-

angia clustered along the branches like grapes.

Usually found in open places in forests in humus or sandy soil, in mountains from 3,000 to 10,000 feet elevation. Known throughout western North America to Alaska, in Nova Scotia and in Europe. Because of the large size, this is the Grape Fern most frequently observed. It may be found in King's River Canyon; Lake Hamilton area in Sequoia National Park; above Mirror Lake, in Little Yosemite Valley and Tuolumne Meadows in Yosemite.

POLYPODIACEAE

FERN FAMILY

Leaves called fronds have their origin from a rhizome which sometimes is very short and condensed, or may be much branched and quite long. This family is distinguished by the spores being borne on the underside of the leaf. Spores are contained within organs

called sporangia, usually clustered in groups called sori. These sori often occur as dots or darkened lines and may or may not be covered by an indusium or cover which is variously in the shape of an umbrella, a flap of tissue, or a rolled leaf margin.



Fig. 9 LEATHERY GRAPE FERN (*Botrychium multifidum* var. *coulteri*). From an open place in the forest in sandy soil, each plant having one compound leaf and a special stalk bearing clusters of sporangia. Plant is about 15 inches high.

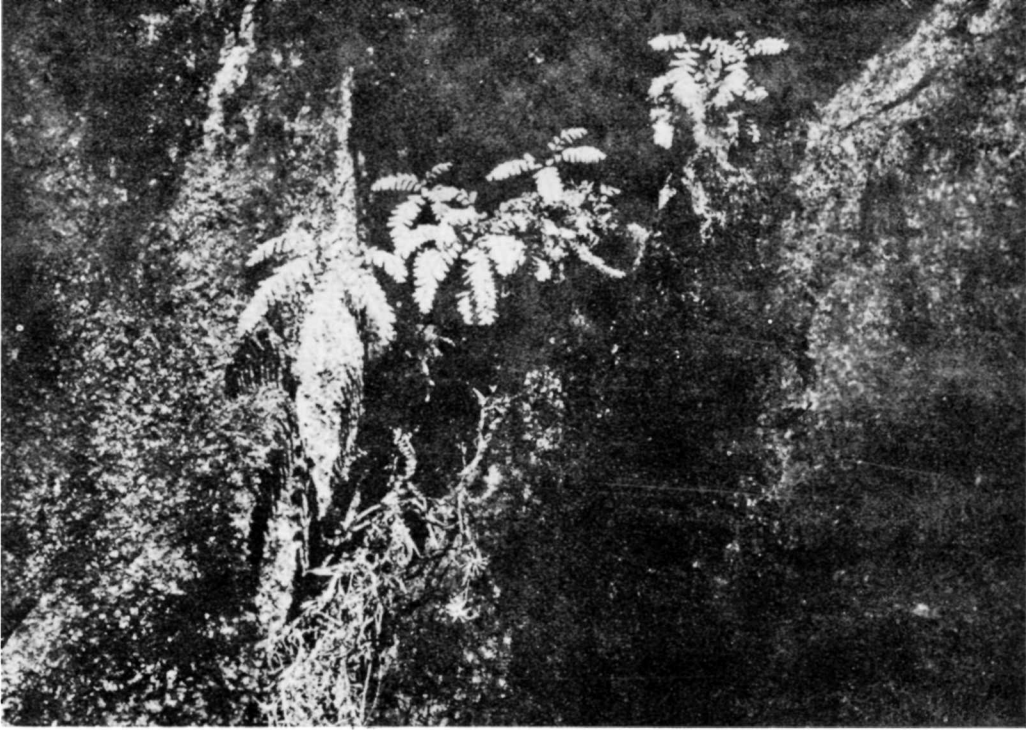


Fig. 10 FIVE FINGER FERN (*Adiantum pedatum*). This fern lives on moist, rocky walls, receiving only a few hours of sunlight each day, or no direct sunlight.

ADIANTUM

A distinctive group containing our most graceful and delicate ferns. The slender leaf stalk is black or brown, often shiny. The extensive underground stems, called rhizomes, may form mats. Sori marginal, the sporangia attached to the reflexed lobes of the segments. Veins of the leaflets, easily visible, divided into two equal divisions each time, never joining or forming a net-like pattern.

These ferns grow in moist places, usually protected from direct sunlight during part or most of the day,

often where they have a north exposure.

Adiantum is used with flowers for corsages, especially when the leaf stalk has been singed in an open flame to prevent wilting. They are commonly cultivated in hanging boxes, and planted in shady corners of gardens. Most native species from higher altitudes die down during the winter. The dark leafstalks were used for black designs in baskets by several tribes of Indians in California (Kroeber).



Fig. 11 Upper: FIVE FINGER FERN (*Adiantum pedatum*). One frond with its finger-like branches. Pinnæ are sterile. Lower right: Fertile pinna of the same species. Lower left: COMMON MAIDEN HAIR (*Adiantum capillus-veneris*). Some pinnæ are sterile, others have moon-shaped marginal sori. Pinnate branches along the entire leaf stalk distinguish this fern from the Five Finger Fern.

KEY TO THE SPECIES:

- Leaf stalk forked only at the top, each fork bearing 3-8 pinnæ
 on upper side *A. pedatum*
- Leaf stalk with branches all along its sides
- Pinnæ not deeply cut between sori, margin of fertile
 pinnules rounded *A. jordanii*
- Pinnæ more deeply incised between sori, margin of
 pinnules irregular *A. capillus-veneris*

FIVE FINGER FERN

***Adiantum pedatum* L.**
 (Fig. 10, 11)

A. pedatum var. *aleuticum*

Distinguished by leaf stalk one or two feet high forked only near summit, each fork bearing a number of pinnæ. Pinnules arranged pinnately, all their sori being on the upper edge. Upper edge incised or notched between sori, lower edge smooth.

Common in higher mountains of the Sierra Nevada from 3,000 to 10,000 feet elevation. It may be observed along several trails leading out of Yosemite Valley as on the horse trail to Nevada Falls, in Sequoia National Park along the middle fork of the Kaweah River. It is known from California to Alaska, in several eastern states, and in Canada from Newfoundland to Ontario.

CALIFORNIA MAIDEN HAIR

***Adiantum jordanii* C. Mull. ex Kuhn**
 (Fig. 12)

A. emarginatum.

Erect fronds $\frac{1}{2}$ to 2 feet high, distinctive because there are pinnate branches all along the leaf stalk. Pinnules nearly round or broadly fan-shaped with sori located at ends of veinlets. Very shallow incisions between two successive sori.

Found in central Sierra foothills from 2,000 to 3,000 feet elevation. It can be observed near the highway west of El Portal, in the vicinity of Copperopolis, La Grange, and Jacksonville, Tuolumne County, in the months of February or March to June. It is common in coastal areas from the northern part of lower California to southern Oregon, and has been reported from western New Mexico.

COMMON MAIDEN HAIR

***Adiantum capillus-veneris* L.**
 (Fig. 11)

Branching similar to *A. jordanii*, but this species has more drooping fronds and pinnæ are more wedge-

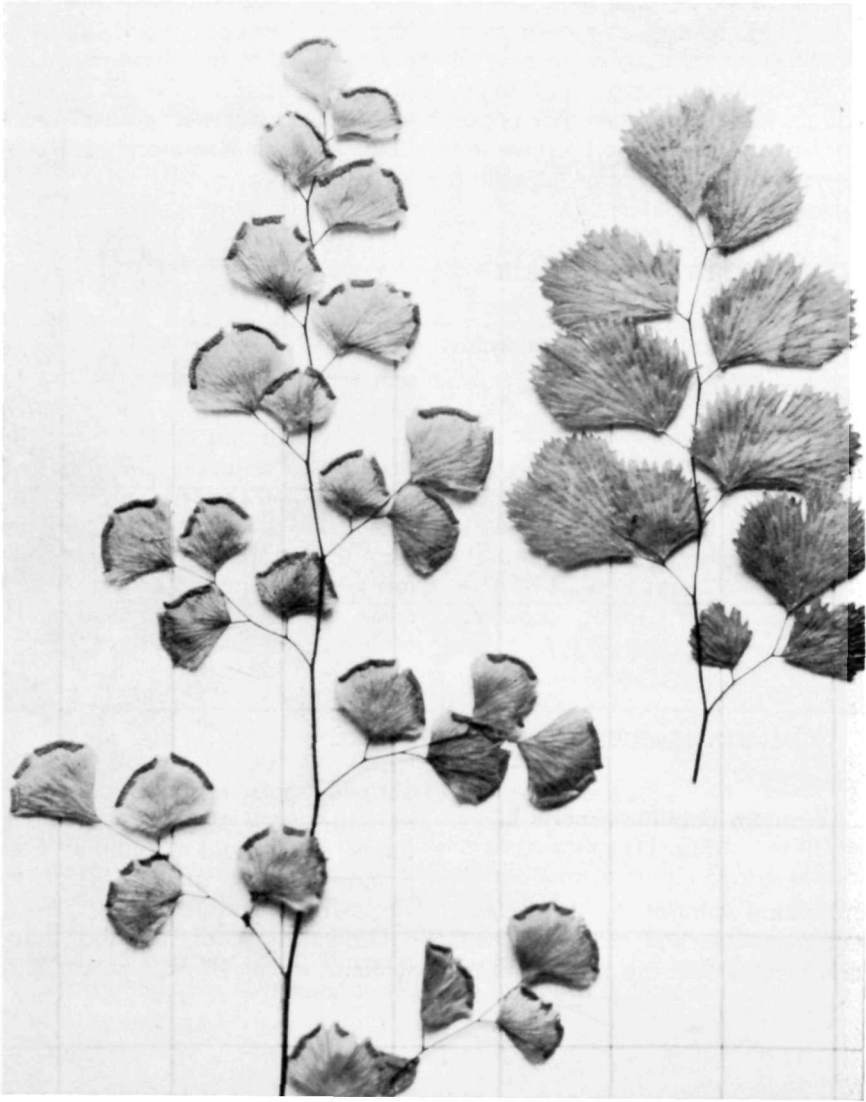
shaped, sori shorter, distinctively moon-shaped, giving the fertile pinnules an irregular outline. Sterile pinnæ deeply incised. Leaf form somewhat variable.

Grows on cool, shaded canyon walls at lower elevations, especially

on lime soils. Although this species is widespread in its total distribution, it is not common in the Sierra. Known in California from the coastal

and inland areas as well as in many scattered locations in the United States and in temperate and subtropical regions around the world.

Fig. 12 CALIFORNIA MAIDEN HAIR (*Adiantum jordanii*). A fertile frond on the left side, a sterile one on the right. This fern closely resembles the Common Maiden Hair in its branching. Here the sori are not moon-shaped and notches between sori are never deeply cut.



ATHYRIUM

Medium to large ferns, rhizome usually unbranched, sometimes tufted. Fronds large, spreading, bi- to tri-pinnate and erect. Sori on underside of pinnae in rows, oblong or

moon-shaped, angled oblique to the midrib. Indusium shaped like sorus or absent. Located in moist places, often shady or protected places in forests, sometimes by streams or meadows.

KEY TO THE SPECIES:

Leaf segments crowded on fronds, indusium oblong to

moon-shaped, fringed with cilia *A. filix-femina*

Leaf segments narrow, oblique, indusium absent *A. alpestre*

LADY FERN

***Athyrium filix-femina* (L.) Roth**
(Fig. 13)

A. filix-femina var. *californicum*

Fronds 2 to 4 feet high, quite broad, often tapering toward the base, arising from a short rhizome. Leaf forms variable from deeply incised with toothed lobes, to completely separate pinnules. Dorsal sori are oblong to moon-shaped, usu-

ally toothed or with hair-like cilia on margins of the indusium.

Grows in shady or protected moist places, often in forests, from 4,000 to 8,000 feet elevation in the Sierra and is known from Idaho to Mexico, and in Europe and Asia.

This fern does well in gardens in cooler climates, especially if given sufficient moisture. It does not tolerate wind.

ALPINE LADY FERN

Athyrium alpestre* var. *americanum
Butters (Fig. 14)

Athyrium americanum
Phegopteris alpestris var. *americanum*
Phegopteris alpestris

Plants $\frac{1}{2}$ to $2\frac{1}{2}$ feet high, usually rather large, fronds nearly tripinnate. Sori round, very small, on veins below the apex of pinnae. Indusium absent. Fronds narrower than preceding species, although

frequently resembling them in appearance.

This fern is found in moist meadows, in ravines and along creeks at higher elevations in the Sierra Nevada from 7,000 to 11,000 feet. It is distributed from California into northwestern Canada and Alaska and it is known from Colorado. It is also known from Lassen Volcanic National Park, and may be seen in Yosemite on Mt. Hoffman, in Iceberg Pass, and along Unicorn Creek.

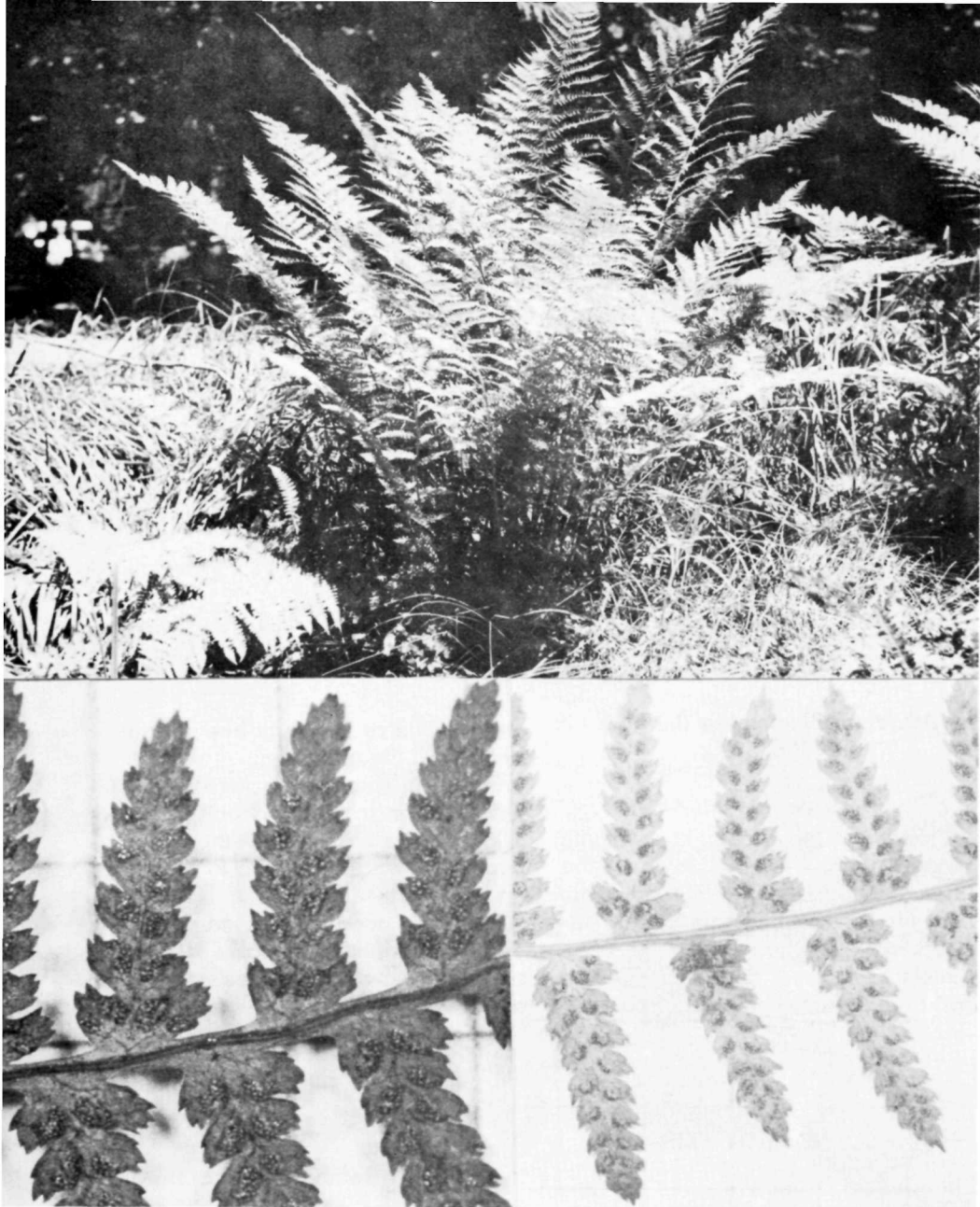


Fig. 13 LADY FERN (*Atyrium filix-femina*). Upper: Habitat in moist soil near a stream in a wooded area. Lower right: Young stage of sori when flap-like indusium covers sorus. Lower left: Older stage when enlarging sporangia in the sorus push back and cover indusium or cause it to fall off.



Fig. 14 ALPINE LADY FERN (*Atbyrium alpestre* var. *americanum*). Left: A small frond. Right: One branch from a large frond. This species has no indusium.

CHEILANTHES

Small ferns usually with some form of glandular hairs or scales on their leaves. Bi- or tri-pinnate leaves in which the fertile and sterile pinnæ look very much alike. Pinnules may be lobed or incised, are often minute and bead-like. Sori may be distinct or continuous around the margins, more or less covered by an extension of the membranous leaf margin which serves as an indus-

ium.

These ferns usually grow in cracks of rocks or on sandy, well drained hillsides, occasionally in seepage. Fronds curl up as the dry season continues and eventually die. The plants put forth new fronds when the rainy season comes, or following the melting of snows. Old fronds sometimes revive during rains.

KEY TO THE SPECIES:

- Pinnæ without hairs or scales
 - Sori distinct, short, moon-shaped, in notches*C. californica*
 - Sori continuous on each side of a segment*C. siliquosa*
- Pinnæ with hairs or scales on the underside
 - Sori not continuous around each segment; ultimate segments flat, glandular hairy on upper and lower surfaces*C. cooperae*
 - Sori continuous around each segment, segments beadlike
 - Underside covered with woolly hairs, segments mostly oval*C. gracillima*
 - Underside covered with membranous lanceolate scales, segments round*C. covillei*

Fig. 15 CALIFORNIA LACE FERN (*Cheilanthes californica*). Left: Growing in cracks of rocks where moisture is available to roots. Right: Sori in notches of deeply lobed or incised leaf.





Fig. 16 INDIAN'S DREAM (*Cbeilanthcs siliquosa*). Upper: Dense clumps form when soil and water conditions are satisfactory. Lower: Details of one frond. Insert: Enlargement of segments to show details of sori.



Fig 17 Above: COOPER FERN (*Cheilanthes cooperae*). Upper: Two fronds and condensed stem. Lower: Enlarged view of lobed hairy pinnæ.

Fig. 18 Right: BEAD FERN (*Cheilanthes covillei*). Commonly grows in cracks of rocks in dry places. Fronds curl in late summer.

CALIFORNIA LACE FERN

Cheilanthes californica (Nutt.) Mett. (Fig. 15)

Plants 6 to 12 inches high, all of the short rhizomes covered with dark scales with pale borders. Pinnæ notched with sori occurring at ends of veinlets in the notches. Indusium formed by the leaf margin, roundish to moon-shaped. Pinnæ bright green

and glabrous.

Found in rocky crevices near moisture, particularly common on talus slopes at the base of cliffs, often in shady places. Occasionally collected in the Sierra foothills south of Butte County between 2,000 and 4,000 feet elevation. It is known from the Arch Rock area and Cascade Creek in Yosemite, and in the hills below Sequoia National Park.

INDIAN'S DREAM

Cheilanthes siliquosa Maxon (Fig. 16)

Pellaea densa

Dense clusters of fronds 4 to 7 inches high arise from branched rhizomes. The slender shiny stalks

reddish-brown in color, fronds triangular in outline, tri-pinnate, at least at the base, bi-pinnate on the remainder of the frond. Segments of pinnæ about $\frac{1}{4}$ inch long, varying from linear to nearly triangular in shape, normally coming to a point at both ends.



Found in exposed rocky places where the roots have access to moisture. Although not common in the Sierra, this species is widespread occurring from Sequoia National Park above Reflection Lake and Black Rock Pass northward into Oregon from 5,000 to 8,500 feet

elevation. It has been observed in Yosemite beside many trails leading out of the valley as well as along the Crane Flat Road near the tunnels. It is also known in the Coast Range, and east to Montana, Wyoming, and eastern Canada, and from British Columbia.

COOPER FERN

Cheilanthes cooperae D. C. Eat.
(Fig. 17)

Dense clusters of fronds, 3 to 12

inches high, pinnæ hairy and sometimes glandular, stalks dark brown, fronds oblong-lanceolate, bi-pinnate, each pinnule oblong, notched or incised, $\frac{1}{8}$ to $\frac{1}{4}$ inch long.

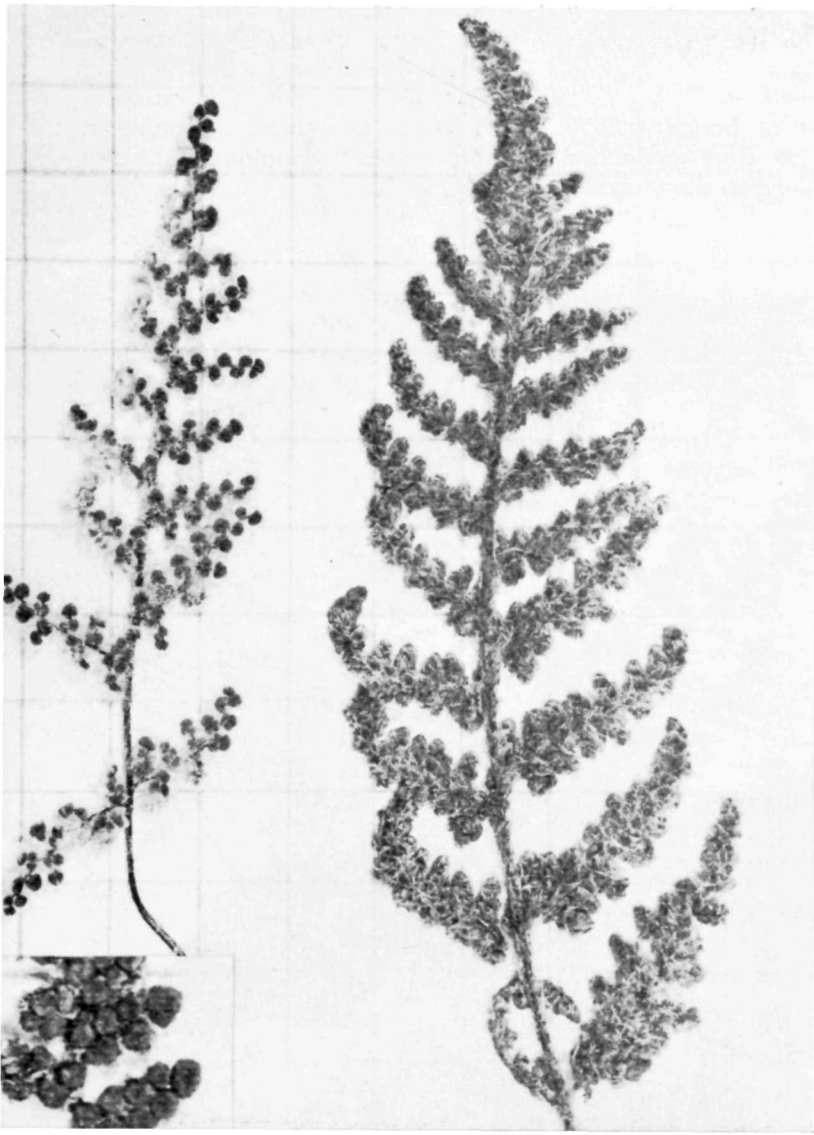


Fig. 19
BEAD FERN
(*Cheilanthes covillei*).
Lower side of two fronds to show variation at one locality. Insert: Top view of bead-like segments.

Not common, occurring occasionally in cracks of limestone cliffs and rocky places in the Sierra Nevada foothills below 2,500 feet elevation.

This fern is known from Hites Cove, Mariposa County, and in a few scattered locations from Eldorado County south into Mexico.

BEAD FERN

***Cheilanthes covillei* Maxon (Fig. 18, 19)**

Plants 2 to 8 inches high, 1½ inches wide at base or less, tri- or quadri-pinnate. Top of fronds green without hairs or scales, lower sides and stalk covered with chaffy scales: white on young fronds, brown on older ones. Sori marginal on bead-

like segments, nearly obscured by the scales. This species closely resembles *C. gracillima* in general appearance.

This species is also known as Coville's Lip Fern. Found on rocky dry ridges, slopes and on peaks. Widely distributed in the Sierra from 2,500 to 6,500 feet elevation as well as in desert areas of southern California, in Arizona and Nevada,

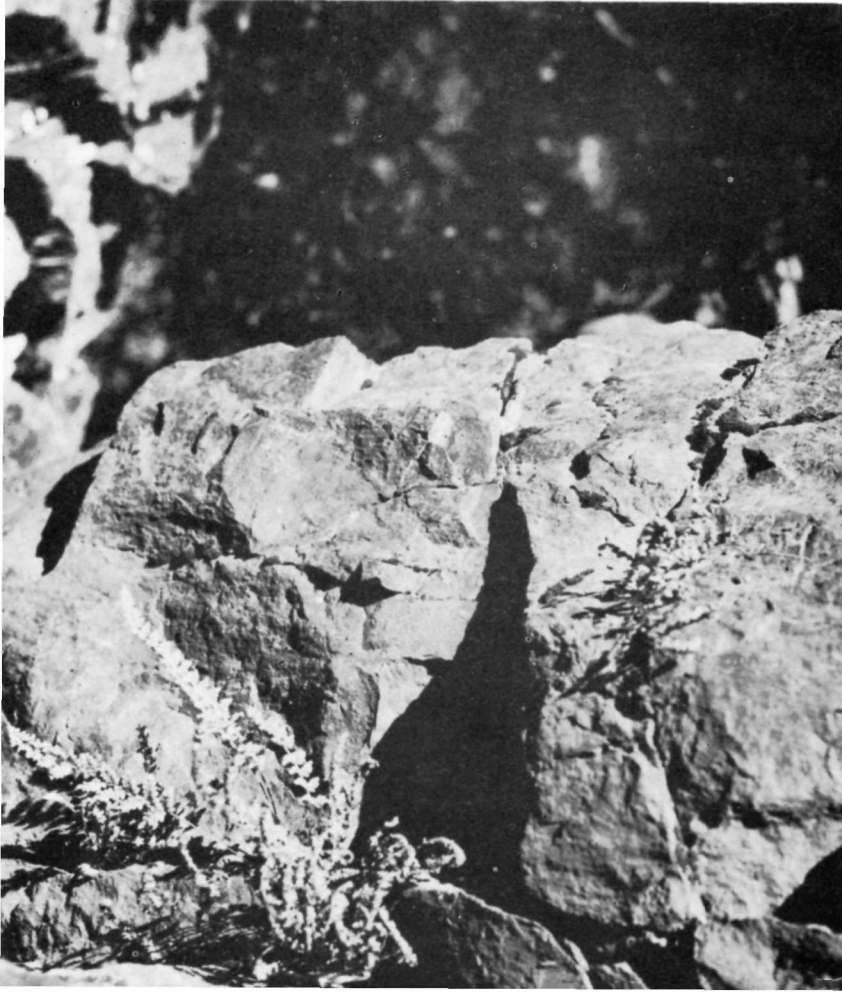


Fig. 20
LACE FERN
(*Cheilanthes
gracillima*)
Found in
cracks of
rocks in very
dry places.

Utah and Lower California. It has been observed in Yosemite Valley at localities on the talus slope, on the south side of the valley near the western boundary of the park.

LACE FERN

***Cheilanthes gracillima* D. C. Eat.**
(Fig. 20, 21)

Clusters of fronds 2 to 8 inches high arise from a single much-branched rhizome, the latter covered with brown papery scales. Stalks without hairs or scales, reddish-brown in color. Bi-pinnate fronds glabrous above, woolly beneath with leaf margins rolled to cover marginal sori. Pinnules more or less oval to linear, frequently with slight lobing, particularly the basal ones of each branch, which may be unevenly lobed.

Distributed in the Sierra from Sequoia to Lassen Volcanic National Parks, ranging from 2,500 to 6,000 feet elevation and is also known from the North Coast Ranges to Idaho and British Columbia. It may be observed in Yosemite along trails leading from Yosemite Valley, including the trail to Merced Lake near Nevada Falls.

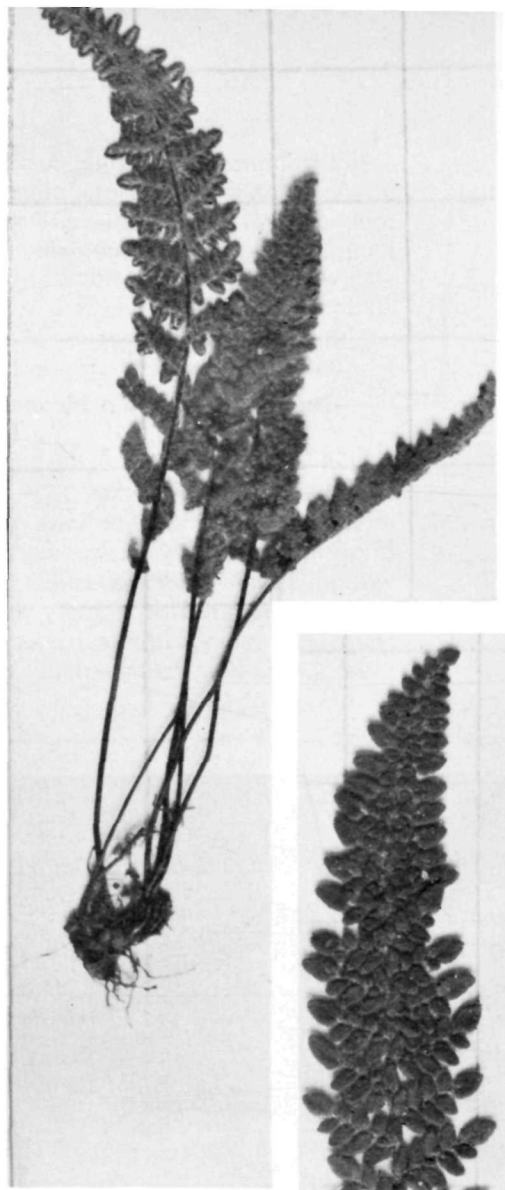
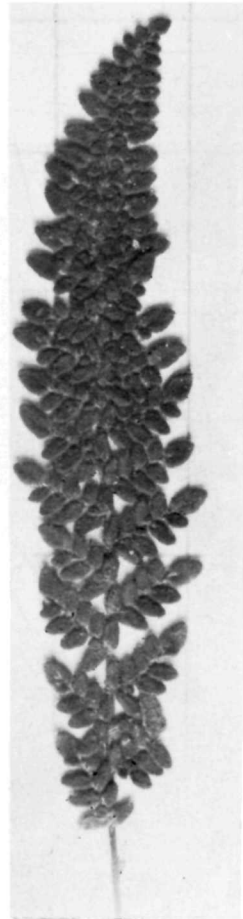


Fig. 21 LACE FERN (*Cheilanthes gracillima*). Upper: One rhizome with several fronds. Lower: Upper side of one frond.

Fig. 22 Far right: PARSLEY FERN (*Cryptogramma crispa* var. *acrosticoides*). The taller fertile fronds with narrow pinnæ contrast to the shorter sterile fronds. Fern is growing in decomposed granite.



CRYPTOGRAMMA

Small ferns whose clustered bi- or tri-pinnate fronds have two distinct intermixed forms: fertile fronds taller with linear to oblong pinnæ.

Rolled margins form a continuous

marginal indusium. Sterile fronds are shorter with ovate pinnæ, notched or cut along the margins. Sori on backs of free veins, running together and covering under side of segment.

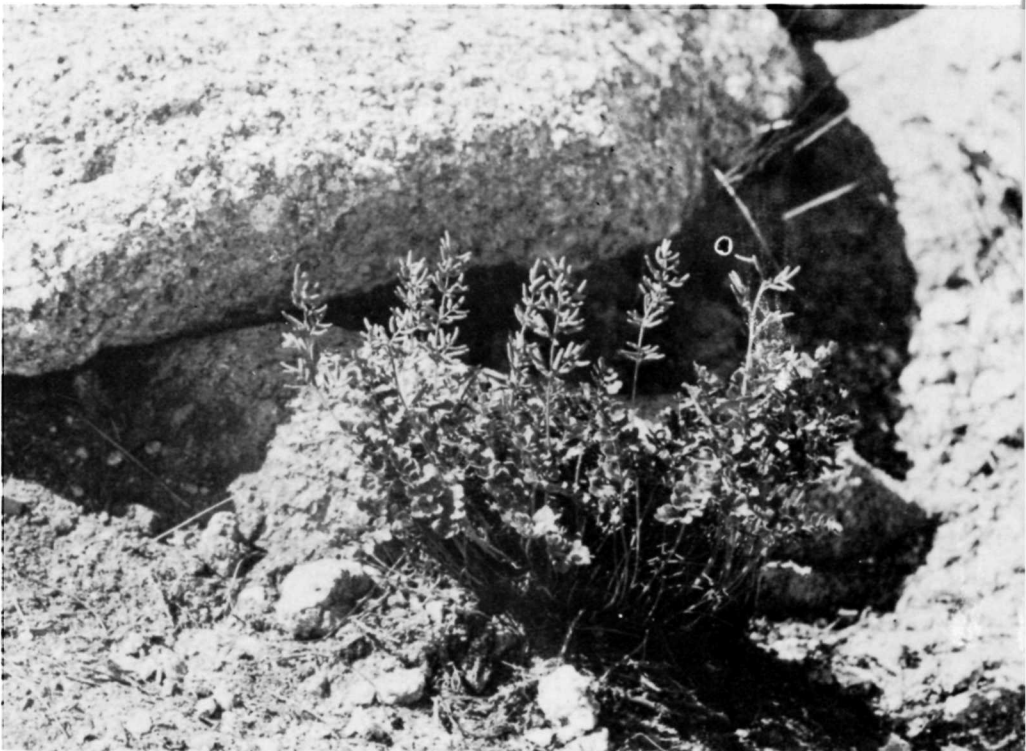
PARSLEY FERN

***Cryptogramma crispa* var.
acrostichoides (R. Br.) Clarke
(Fig. 22, 23)**

C. acrostichoides

Plants 2 to 9 inches high, the fertile fronds taller than the sterile ones. On sterile branches a narrow wing follows from the flat pinna down the stalk, the wing usually absent in the fertile stalk, or scarcely winged.

American Rock Brake is another common name for this species. Distributed from 5,000 to 10,000 feet elevation, more common in the higher elevations, in cracks of granite rock. Known from Alaska, Labrador, around the Great Lakes, and in Nebraska and New Mexico. It may be observed above Tenaya Lake, along trails leading out of Tuolumne Meadows and on Sentinel Dome in Yosemite.



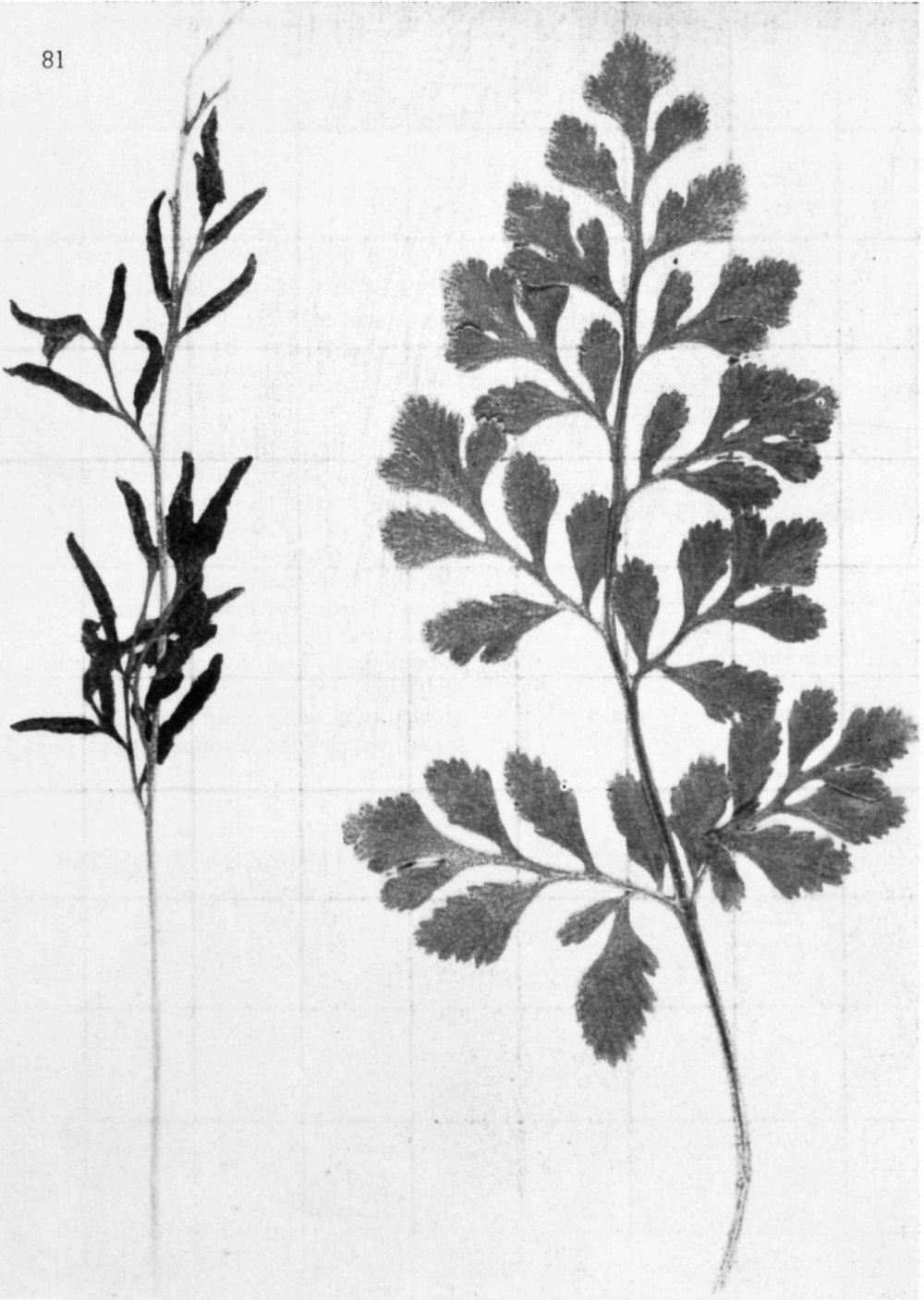


Fig. 23 PARSLEY FERN (*Cryptogramma crispa* var. *acrostichoides*). Left: A fertile frond, usually projecting several inches above the sterile frond, as seen on the right.

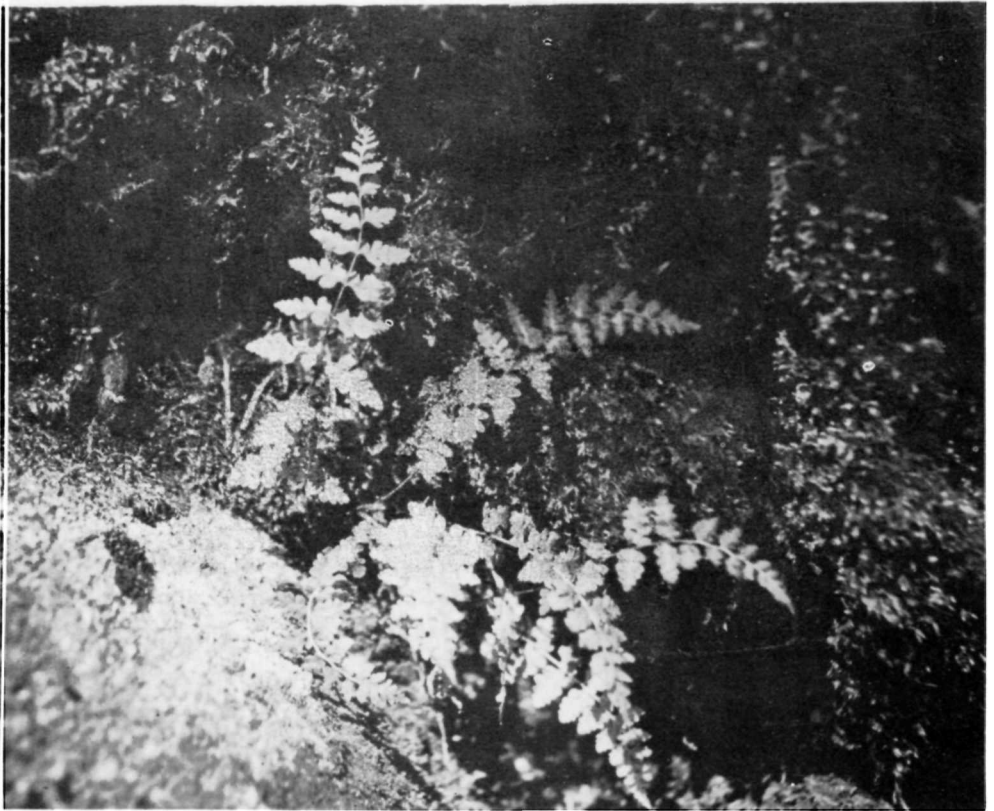
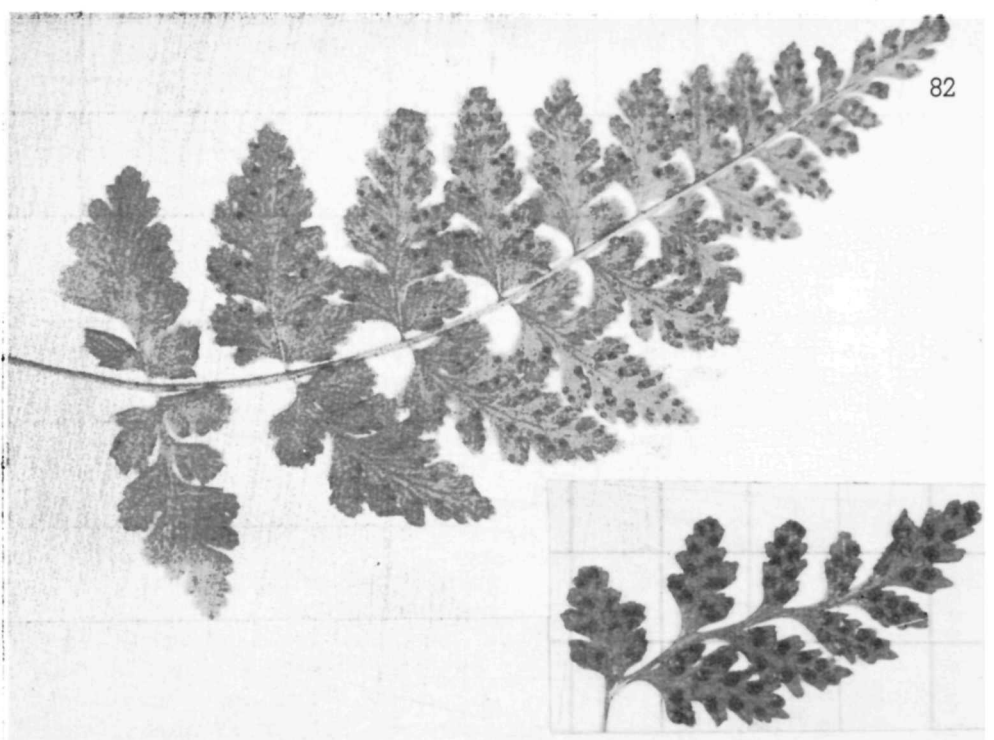


Fig. 24 FRAGILE FERN (*Cystopteris fragilis*). Upper: Frond with scattered sori. On some fronds basal pinnae also have sori. Insert: Close-up of one pinna from a larger frond. Lower: From a cool, moist, shady place. This one received moisture from the spray of a waterfall.

CYSTOPTERIS

Small delicate fronds arising from a slender rhizome. Fronds bi- or tri-pinnate, slender, quite delicate. Small round sori on underside of the pinnae on free veins and covered with a membranous hood-like toothed indusium attached at the

inner side of the pinna and partly folded under the very young sorus. The indusium is best observed in a young frond, soon being pushed back by the enlarging sorus, later withering and somewhat deciduous so that the old sorus may appear naked.

FRAGILE FERN

Cystopteris fragilis (L.) Bernh.
(Fig. 24)

Polypodium fragile
Filix fragilis

Plants 4 to 16 inches high with bright green lanceolate fronds, variable in form. Some are pinnately to nearly bi-pinnately compound because of deeply cut lobes. In others, leaf tissue close to the branches of the stalk may connect most or all leaflets together on a single branchlet of a frond. Young sori black, scattered on under side of pinnae, always located over a veinlet. After

spores are shed, sori appear brown.

Sometimes called Brittle Fern, because fronds break off easily. The fronds of this fern resemble our Woodsias in size and general appearance, but the Woodsias are darker green and never have black sori. Sori of the latter are in rows near the leaf margin, not scattered. This fern grows in sheltered moist places, often along stream banks or in wooded areas. This is a widely distributed fern, occurring from Newfoundland and Labrador to Alaska, scattered locations throughout the United States, in Greenland, Iceland and Eurasia.

DRYOPTERIS

Large, upright ferns arising from a creeping sometimes woody rhizome. Fronds pinnate or bi-pinnate, occurring as single stalks or more often in clusters. Sori round, cov-

ered by a distinctive kidney-shaped indusium which is attached to the pinna at the sinus of the indusium. A large genus in which most species are tropical.

CALIFORNIA WOOD FERN

Dryopteris arguta (Kaulf.) Watt.
(Fig. 25, 26)

Aspidium rigidum var. *argutum*

Several stout evergreen fronds 1

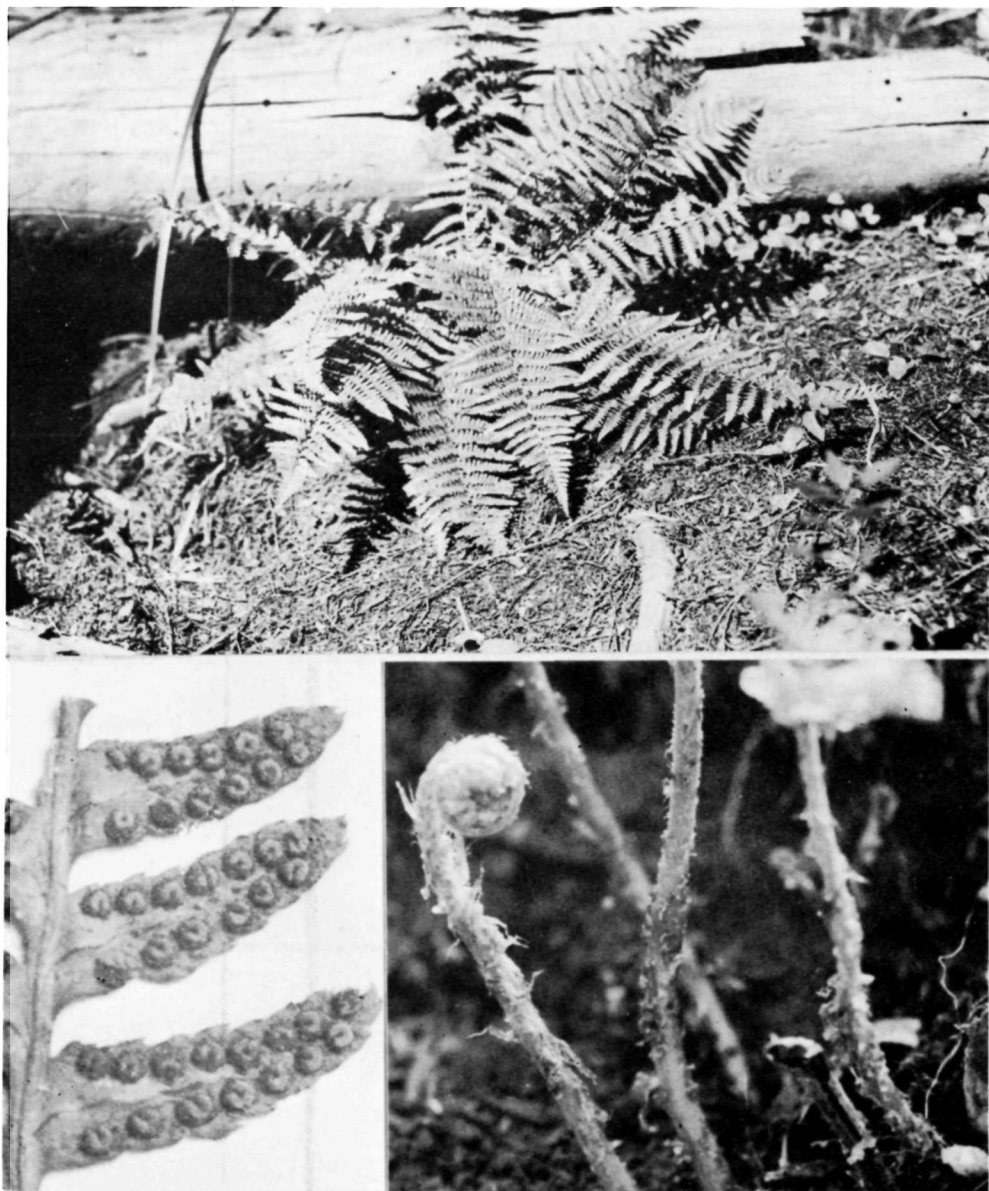
to 2½ feet high and 6 to 10 inches wide grow from each woody rhizome. Fronds bi-pinnate or nearly so, almost leathery in texture, without hairs on the upper side, but somewhat glandular beneath. Pinnae

lanceolate, deeply lobed or incised, with kidney-shaped indusium which makes this species easy to recognize.

Sometimes this species has been

called the Coastal Wood Fern. The California Wood Fern is commonly associated in the Sierra with the Sword Fern from 2,000 to 6,000 feet elevation, and they occur together

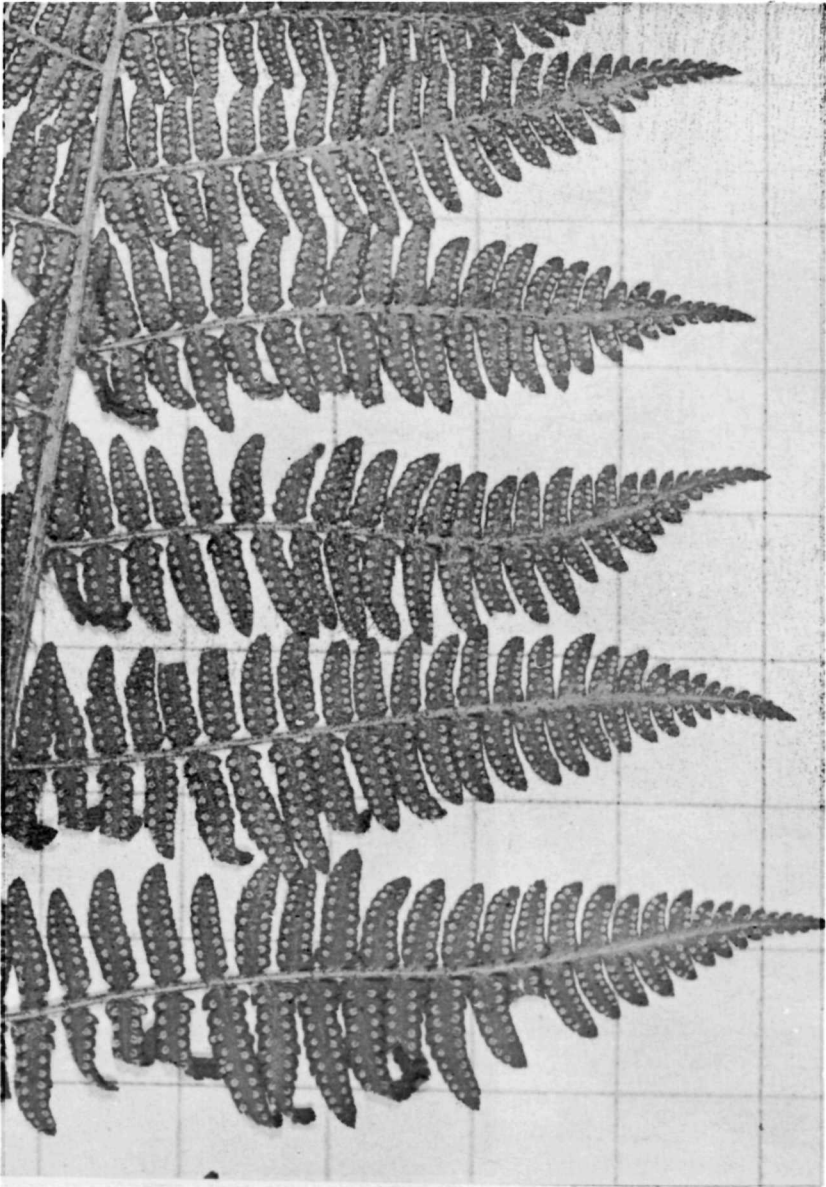
Fig. 25 CALIFORNIA WOOD FERN (*Dryopteris arguta*). Upper: Growing in an open place in the woods. Lower left: View of the lower side of a portion of one pinna to show the kidney-shaped indusium. Lower right: New fronds coming out of the ground.



in semi-moist places throughout the state of California. They attain their greatest size in the foggy coastal mountains. The California Wood Fern may be seen on most trails leading out of Yosemite Valley, es-

pecially toward Nevada Falls and Yosemite Falls, and in Sequoia National Park at Bubbs Creek and Crystal Cave areas. It ranges from San Diego County to British Columbia and occurs in Arizona.

Fig. 26 CALIFORNIA WOOD FERN (*Dryopteris arguta*). Portion of one large frond with kidney-shaped indusia.



PELLAEA

Small ferns arising from stout nodular or slender much-branched rhizomes. Erect pinnate to quadripinnate fronds usually without hairs or scales; smooth or shiny straw-colored to dark brown leaf stalks with scales at the base only. At the ends of veinlets, sori form a marginal or rarely sub-marginal band. Leaf margin curled over sori to form an indusium or only slightly curled in older fronds of *P. bridgesii*. Although there is some question if this species should remain in this genus, it will be placed here until further study when a more accurate placement can be determined. This genus

has about 70 species commonly found in temperate regions of the world. With 6 species and varieties in the Sierra it is one of the largest genera among our ferns.

All species in California occur in well drained, often dry situations. Mrs. Alice Tryon has noted that the British introduced a number of species in this genus to Kew as houseplants over 100 years ago, and that seven species were common in the nursery trade in the years that followed. A number of species grow well in cultivation with little special care other than rock substrata and good drainage. They can be maintained indoors as potted plants also.

KEY TO THE SPECIES

Segments with sharp tips

Pinnæ semi-circular, segments longer than the midrib
of the pinnæ*P. brachyptera*

Pinnæ ovate-linear, segments shorter than the midrib
of the pinnæ

Fronds green, fewer than 20 segments per pinna*P. mucronata*
var. *californica*

Fronds blue-gray or whitish, few to 40 segments
per pinna, often with segments paired or in
clusters of 3's*P. mucronata*
var. *mucronata*

Segments blunt or notched at apex

Fronds pinnately compound
Segments entire, flat or folded in half*P. bridgesii*

Segments deeply lobed, often mitten-shaped,
margins rolled under*P. breweri*

Fronds bi- or tri-pinnately compound*P. andromedacifolia*

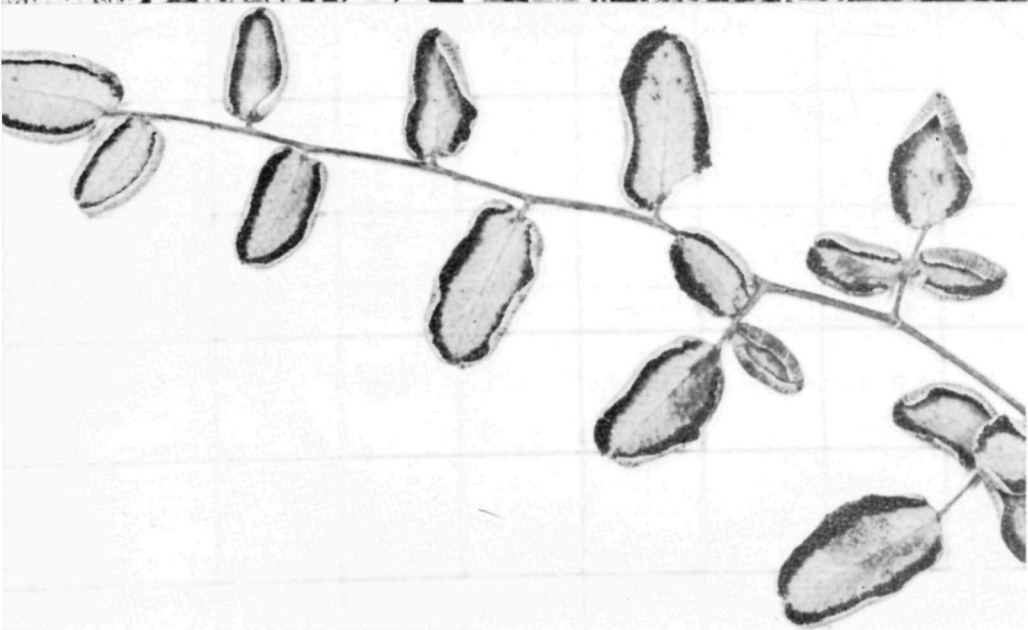


Fig. 27 COFFEE FERN (*Pellaea andromedaefolia*) Upper: Plant in dry foothill area. The curling of the leaves give the illusion of "coffee berries" Lower: Underside of a few segments showing marginal sori.

Fig. 28 Right: SIERRA CLIFF BRAKE (*Pellaea brachyptera*). One frond with its very short lateral branches. Leaf margins curl around sori.

COFFEE FERN

Pellaea andromedaefolia (Kaulf.) Fee (Fig. 27)

Plants 10 to 18 inches high, fronds bi- to quadri-pinnate, several arising from a slender rhizome. Young leaf stalks yellowish, straw or red-brown. Segments $\frac{1}{4}$ to $\frac{1}{2}$ inch long, oval to somewhat rounded with blunt or notched apex. Foliage on upper side whitish or dull green in spring, turning bronze-purple in the drier summer weather, pale yellow or green beneath. In older fronds, especially in dry conditions, segments appear somewhat narrower because of curled margins.

The curled segments and bronze color give the illusion of coffee berries, hence the common name, Coffee Fern. The common name Sheep Fern has been used in a few localities because fragmented stalks puncture the intestines and cause death of sheep which occasionally eat this fern.

Common in the foothill areas of the Sierra in dry rocky places from 1,000 to 3,500 feet elevation, and in the coastal regions from Lower California into Oregon. It has been observed in Yosemite near Arch Rock and is abundant in the foothills below Sequoia National Park.



SIERRA CLIFF BRAKE

Pellaea brachyptera (Moore) Baker (Fig. 28)

Plants 6 to 10 inches high with several slender fronds arising from each rhizome. Woody rhizome is

covered with brown scales. Bi-pinnate fronds have 3 to 6 pairs of pinnules crowded on short pinnate branches.

In rocky, exposed places, this fern grows between 3,500 and 8,000 feet elevation in the northern part of the Sierra including Lassen Volcanic National Park, into Oregon and in Trinity County.



Fig. 29 BREWER'S CLIFF BRAKE (*Pellaea breweri*) Upper: habitat of this delicate fern is at high elevations. Ferns are nearly prostrate when growing under rocks, erect in open places. Lower: Underside of two fertile fronds with lobed pinnae.

BREWER'S CLIFF BRAKE

Pellaea breweri D. C. Eat.
(Fig. 29)

Plants 5 to 9 inches high with fronds in clumps. Short rhizomes covered with long brown scales. Stalks red-brown, quite brittle with dark brown scales near the base. Pinnately compound fronds with bilobed pinnae, or lower pinnae irregularly tri-lobed. This species closely resembles *P. bridgesii* which has no lobes on the pinnae. This species is much more fragile.

Among or under granite rocks between 7,000 and 11,000 feet elevation in the Sierra Nevada, lush fronds lie nearly prostrate under



rocks, but plants in open are shorter, erect, but still fragile.

Sometimes this species has been called the Sierra Cliff Brake. This fern was first collected by Professor W. H. Brewer in 1864 near Sonora Pass between 7,000 and 8,000 feet elevation. It is known from the vicin-

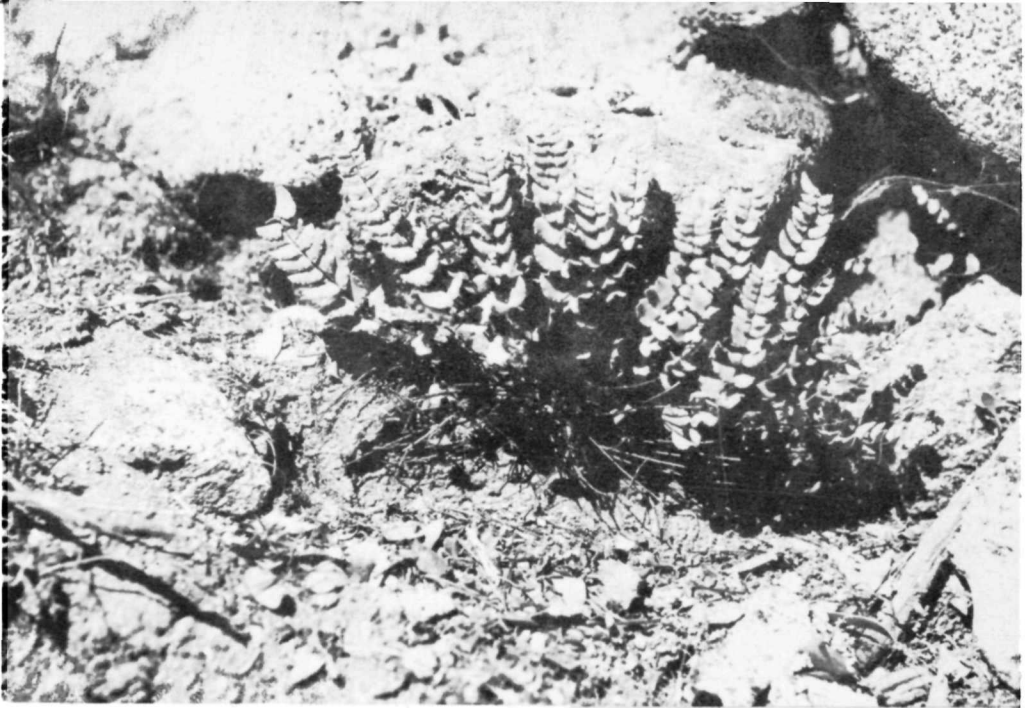


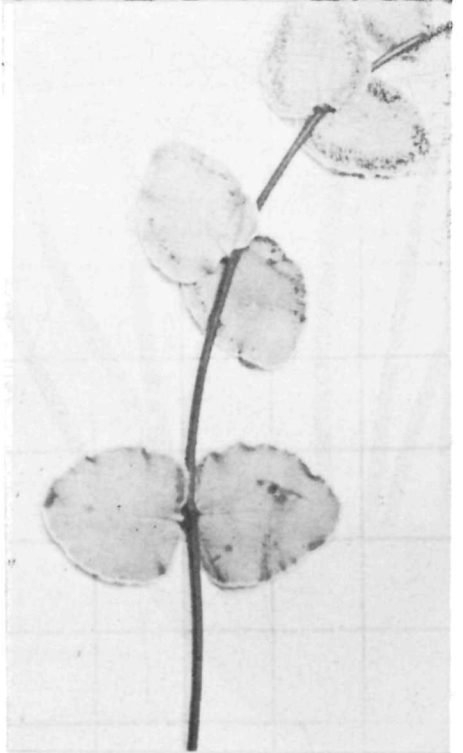
Fig. 30 BRIDGES' CLIFF BRAKE
(Pellaea bridgesii). Upper:
 Growing in sandy soil and
 among granite rocks in dry
 places. Lower: Underside of
 frond showing scattered
 sub-marginal sporangia on
 all but lower pair of pinnae.

ity of East Lake, Kings Canyon National Park, Pear Lake in Sequoia National Park, from Mono Pass and in several mountains near Mt. Dana in Yosemite, and from Washington, Wyoming and Utah.

BRIDGES' CLIFF BRAKE

***Pellaea bridgesii* Hook.**
(Fig. 30)

Plants 4 to 8 inches high arising from a short rhizome which is covered with masses of brown scales. Clusters of pinnate fronds with lustrous brown stalks arise from each rhizome. Pinnae round to ovate, light green in color with a leathery texture. Sori form a submarginal band



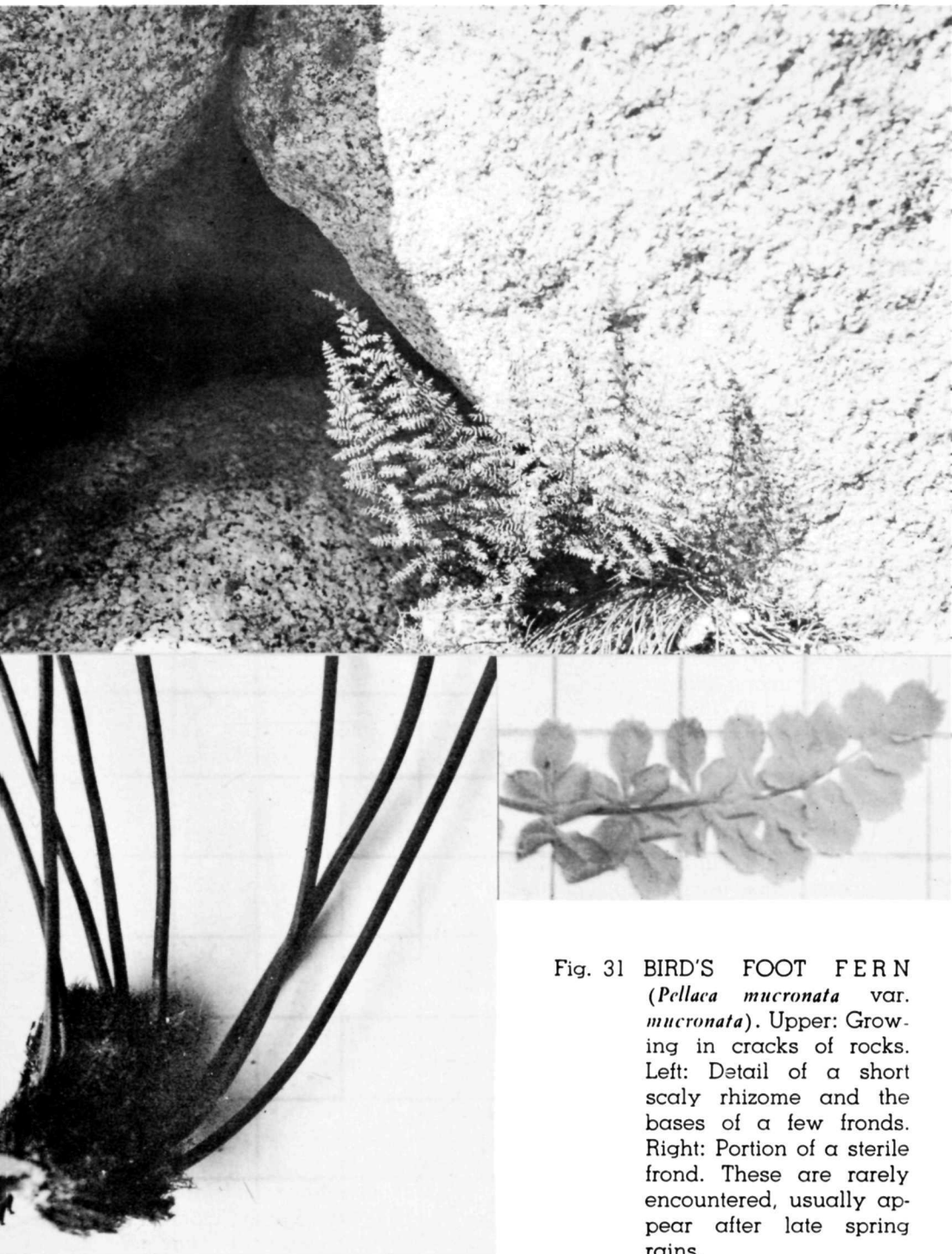


Fig. 31 BIRD'S FOOT FERN
(Pellaea mucronata var.
mucronata). Upper: Grow-
 ing in cracks of rocks.
 Left: Detail of a short
 scaly rhizome and the
 bases of a few fronds.
 Right: Portion of a sterile
 frond. These are rarely
 encountered, usually ap-
 pear after late spring
 rains.

which apparently at no time has a true curling of the leaf margin to protect it. These latter characters and additional features may eventually be a basis to place this species in another genus.

It may be found in cracks of granite rocks in dry exposed places 5,000 to 11,000 feet elevation from

Tulare County, many localities in Yosemite, northward through the Sierra to Oregon and western Idaho. It may be seen near the animal trail a short way below Nevada Falls in Yosemite, along the main road in Forest of the Giants, Sequoia National Park, and along the Sonora Pass Road.

BIRD'S FOOT FERN

***Pellaea mucronata* var. *mucronata*
(D. C. Eat.) Tryon
(Fig. 31, 32)**

P. ornithopus

P. mucronata

Plants 8 to 18 inches high, arising from a woody nodular branched rhizome. Young stalks of fronds chestnut to black, wiry and brittle. Bluish-gray evergreen fronds usually tri-pinnate, at least in mature fronds, bi-pinnate in younger ones. Pinnæ, at least at bottom of fronds, often in clusters of threes resembling a bird's foot. Pinnæ linear or elliptical with a sharp-pointed apex.

Jepson says this fern is sometimes called the Tea Fern, Black Fern, and

Poison Fern. Like the Coffee Fern, *P. andromedaefolia*, the wiry stalks break into sharp pieces when eaten by sheep or goats, penetrate the intestines and cause death. According to Barrett and Gifford, the rhizomes which are sometimes 20 feet long were dug by Miwok Indians and used for brown coloring in their baskets. Also portions of this fern were steeped in hot water and the tea drunk to stop nosebleed or as a blood purifier.

This fern is common throughout the Coast Range and the Sierra in dry rocky places from 400 to 5,000 feet. It is found on the talus slopes in Yosemite near Arch Rock and extends southward into Lower California.

DESERT CLIFF BRAKE

***Pellaea mucronata* var. *californica*
(Lemmon) Munz & Johnston
(Fig. 33)**

P. compacta

P. wrightiana var. *compacta*

Small fern, 4 to 8 inches high with several stalks arising from each rhizome. Young stalks dark brown to black. From 3 to 7 ovate pinnules on each branch of a bipinnate frond. Pinnules curl when drying.

A fern distinctive from Bird's Foot Fern by having many fewer pinnules, never occurring in threes, and by having broader pinnules. This variety differs from the Sierra Cliff Brake by having longer lateral branches on which the pinnules are borne so that the segments are not so crowded.

Observed by the author only on the Avenue of the Giants in Sequoia National Park near Dorset Creek. Known only from a few localities in central and southern California.

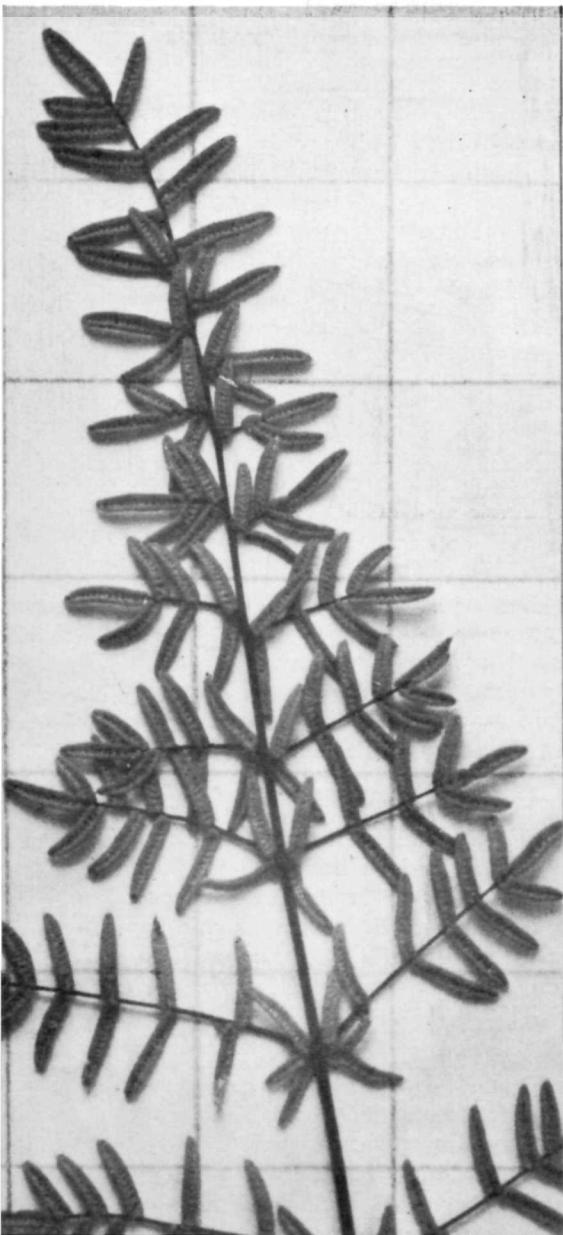


Fig. 32 Above: BIRD'S FOOT FERN (*Pellaea mucronata* var. *mucronata*). Two fronds showing lower side with curled leaf margins. In specimen on right many segments occur in threes, and thus resemble a bird's foot, the origin of its common name.

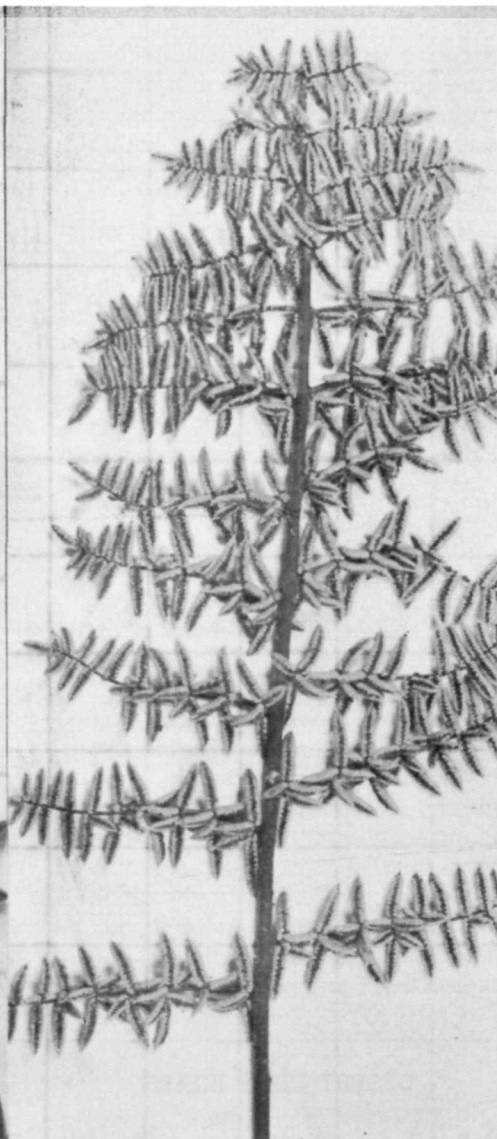


Fig. 33 Right: DESERT CLIFF BRAKE (*Pellaea mucronata* var. *californica*). Two fronds from one plant showing variation in number of pinnules and in width of pinnules. Fronds are somewhat immature.

PITYROGAMMA

Small ferns having clusters of fronds with slender dark stalks. Fronds triangular or 5-sided in outline, undersides covered with white or yellow waxy powder. Sori appear black in mature fronds, in contrast to the light colored waxy particles. Sori follow the very small veinlets, but are so crowded that their forked

or pinnate arrangement is obscured and the underside of each pinna appears to have one large confluent sorus. No indusium is present.

Although about 15 species of this genus are known in the world, mostly in tropical areas, only one species with several varieties, all found in California, occur in the United States.

KEY TO THE SPECIES:

Fronds dark green above, golden yellow beneath when young *P. triangularis*
Fronds white above and beneath, and white on stalksvar. *pallida*



GOLD FERN

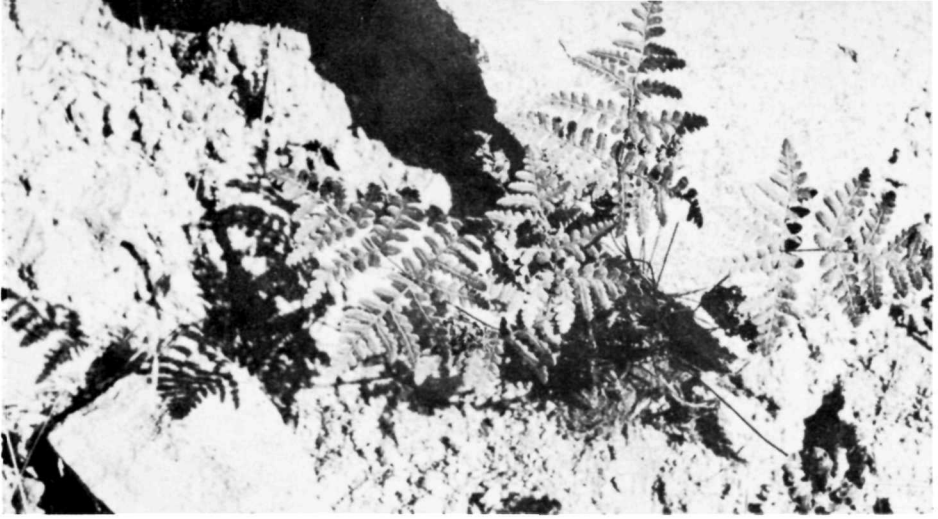
***Pityrogramma triangularis* (Kaulf.)
Maxon (Fig. 34)**

Gymnogramme triangularis

Fronds 3 to 12 inches high, easily recognized by its triangular shape, dark green color above and waxy golden yellow underneath on young fronds. As fronds mature most of the underside is covered with black sporangia, as shown in the illustration.

Gold Back Fern and Stamp Fern are other common names for this fern. An attractive golden print results when the underside of a young frond is pressed upon dark cloth or paper. This species, states Barrett and Gifford, was chewed for toothache by California Indians, care being taken to keep the quid near the troublesome tooth.

The Gold Fern is one of our more common ferns throughout the whole foothill area of the Sierra Nevada up to 4,500 feet elevation, and in the Coast Range. It occurs in damp places in sun or shade, in soil or cracks of rocky ledges. As the soil



dries out, the fronds curl and die. The plants remain dormant until the next rainy season when they produce new fronds. This species is found from Lower California to Alaska, and in Idaho and Arizona.

WHITE FERN

***Pityrogramma triangularis* (Kaulf.)
Maxon var. *pallida* Weatherby
(Fig. 35, 36)**

A rare variety, closely resembling the preceding species, but distinguished by the whitish, waxy granules covering upper and lower leaf surfaces and also the stalk. As with the Gold Fern, the lower surface is gradually obscured by the dark sporangia which develop over the veins and cover much of the lower leaf surface. However, the underlying color of the top of the leaf in the White Fern is always a pale green, never dark green as in the preceding species.

This plant is occasionally found in the Sierra foothills below Sequoia and Kings Canyon National Parks, in Mariposa and Tuolumne Counties, and has been reported from Butte County. It is found in Yosemite near Arch Rock, but usually occurs at lower elevations.



Fig. 34 GOLD FERN (*Pityrogramma triangularis*). Upper: Found in soil where moisture is available during the winter and spring months. Lower: Details of lower side of one frond when black sporangia cover most of the gold waxy particles.



Fig. 35 WHITE FERN (*Pityrogramma triangularis* var. *pallida*). Growing under granite boulders which form a cave. These ferns never grow in direct sunlight, although this variety may occur in more open places. White waxy material covers the stalks and both upper and lower surfaces of the fronds.

POLYPODIUM

Polypody

Small ferns with spreading rhizomes and glabrous deeply lobed or pinnate fronds. One row of sori is located on each side of the midrib of the pinna or lobe and no indusium is found in this genus. The rhizomes usually are found in cracks of rocks

or form mats covering rocks or imbedded in soil or moss.

Rhizomes of these ferns have long been enjoyed by the Indians of California both raw and roasted as a confection. Some species are reported to have medicinal value.

KEY TO THE SPECIES:

- Pinnately compound fronds with sharp incisions between compact pinnae, from sea level to 4,000 feet elevation*P. vulgare* var. *kaulfussii*
 Pinnately lobed simple frond with broad spacing between pinnae, from 5,000 to 8,000 feet elevation*P. vulgare* var. *columbianum*

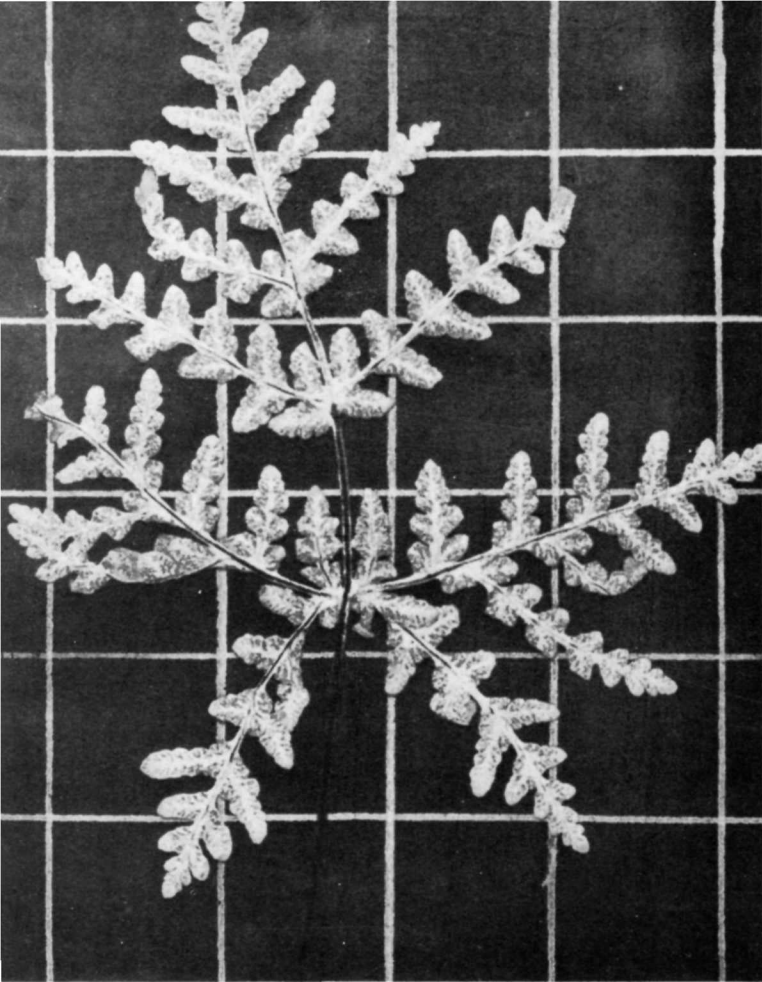


Fig. 36 Left:
WHITE FERN
(Pityrogramma triangularis var. pallida). Lower side of one frond with young sporangia partially obscuring the white waxy material.

Fig. 37 Right:
LICORICE FERN
(Polypodium vulgare var. kaulfussii). Habitat view and close-up for details.

LICORICE FERN

***Polypodium vulgare* L. var. *kaulfussii* (D. C. Eat.) Fernald (Fig. 37)**

P. californicum
P. vulgare var. *intermedium*

Slender fronds 2 to 18 inches high arise from rhizomes covered with papery brown scales. Membranous fronds which appear pinnately compound with considerable variation in shape and margins from long slender lobes to short, stout ones, margins toothed or not. Circular distinct sori $\frac{1}{8}$ inch broad or sometimes larger. Sori yellow when very young,

soon turning brown. The fronds grow erect, but sometimes droop.

Found on banks of canyons or in cracks of rocks, often where there is some seepage, in Sierra Nevada foothills from Butte to Fresno Counties, usually below 4,000 feet elevation, and coastal California. This species grows near the base of Yosemite and Cascade Falls in Yosemite, growing in cracks of rocks in spray from the falls. The fronds die down when the falls and their spray decrease in volume, then plants remain dormant until the following spring. This variety is distributed from central California to Lower California.

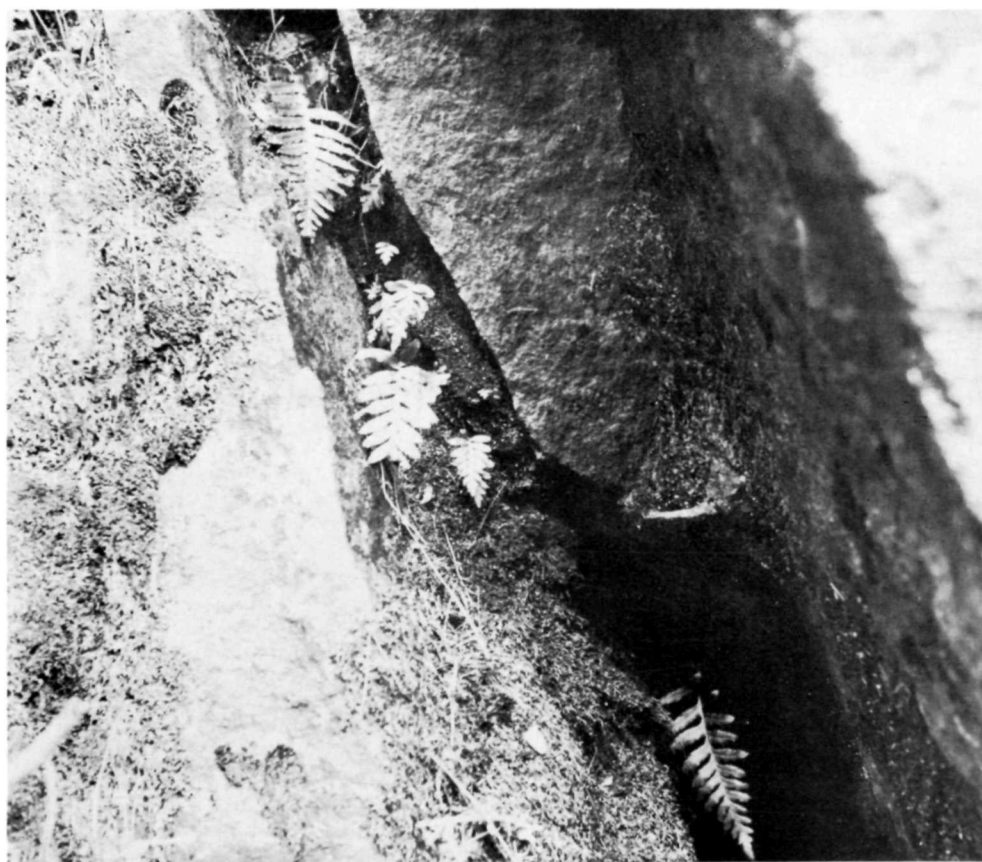




Fig. 38 GOLDEN POLYPODY (*Polypodium vulgare* var. *columbianum*). Growing in seepage under a granite ledge so that direct sunlight never reaches the plant.

GOLDEN POLYPODY

***Polypodium vulgare* var.
columbianum Gilbert
(Fig. 38, 39)**

P. hesperium

P. virginianum L. as given by Jepson is a mis-identification.

Plants 4 to 14 inches high from a rhizome similar to the preceding variety. Fronds pendent, somewhat leathery, pinnate lobes with considerable spacing, sori golden colored when young, from whence the plant receives its common name.

Known from the central Sierra

region from 5,000 to 8,000 feet elevation. It is not common and has been collected by this author only behind Strawberry Lake, Tuolumne County, at 6,000 feet elevation. This variety was first observed there nineteen years ago. The fern grows under a granite ledge, entirely shaded from direct sunlight and in constant seepage. It has not spread to other places in the intervening time. It is an evergreen when grown in cultivation. The known distribution extends from British Columbia to southern California and into South Dakota.

POLYSTICHUM

Sword Fern

Few to many fronds arise on the end of a stout rootstock. Evergreen fronds have a leathery texture, leaf bases are covered with papery brown scales. A large lobe occurs on upper side at base of each pinna. Sori are round with a peltate indusium, i.e., like an umbrella, but smooth around the margins.

SWORD FERN

***Polystichum munitum* (Kaulf.) Presl.**
(Fig. 40, 41)

Dark green shiny fronds 1 to 2 feet or occasionally as much as 3 feet long, lanceolate in outline, and pinnate. Round indusium slightly depressed in the center where stalk of the indusium is attached. Mature sporangia normally protrude beyond the edge of the indusium. Sori arranged in 2 rows down each pinna, the margins of pinnae being serrately toothed, the apex acute.

The Sword Fern and its variations are easily transplanted into gardens if kept in cool or at least partially shaded areas. It makes an excellent addition to bouquets because its shiny dark green fronds last well if kept in water and the pinnae do not drop off.

This species occurs in the Sierra Nevada up to 7,000 feet in elevation in open and wooded places where there is sufficient moisture. It is common in the Coast Range in the Redwood belt and is found as far north as Washington and Alaska, and in western Montana.

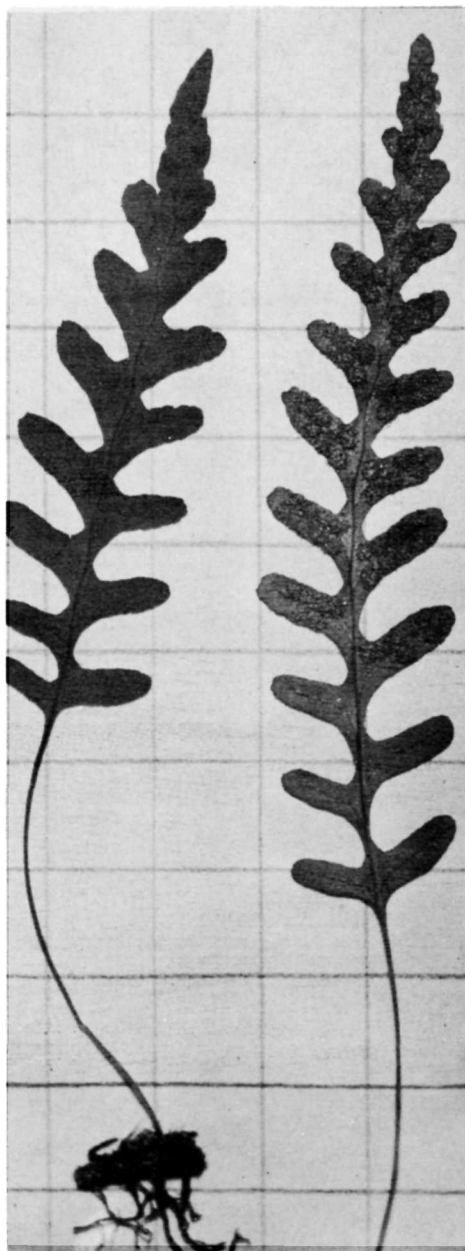


Fig. 39 GOLDEN POLYPODY (*Polypodium vulgare* var. *columbianum*). Left: Portion of a rhizome and upper side of attached frond. Right: Lower side of one frond with naked sori. Some fronds have sori on all lobes.

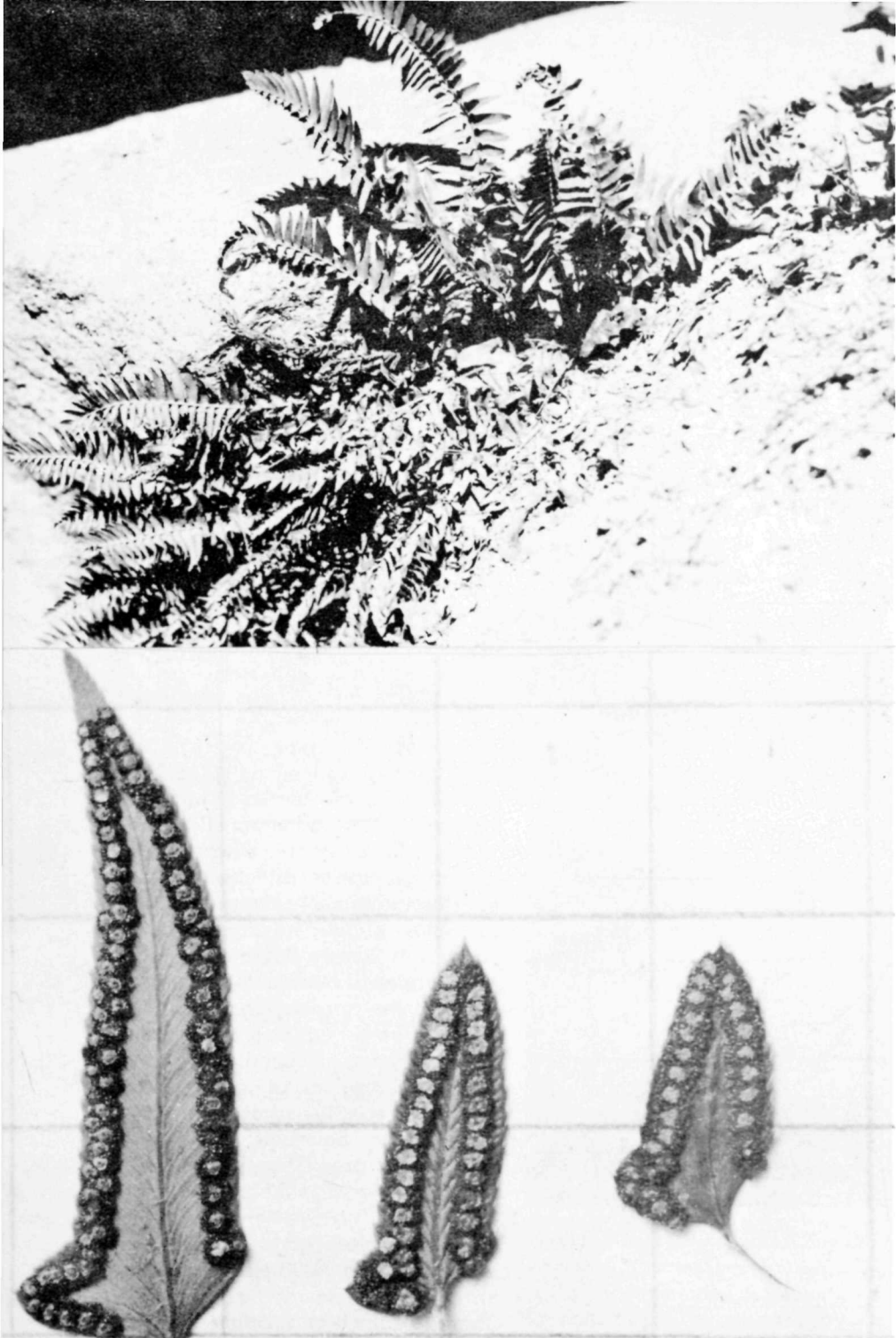
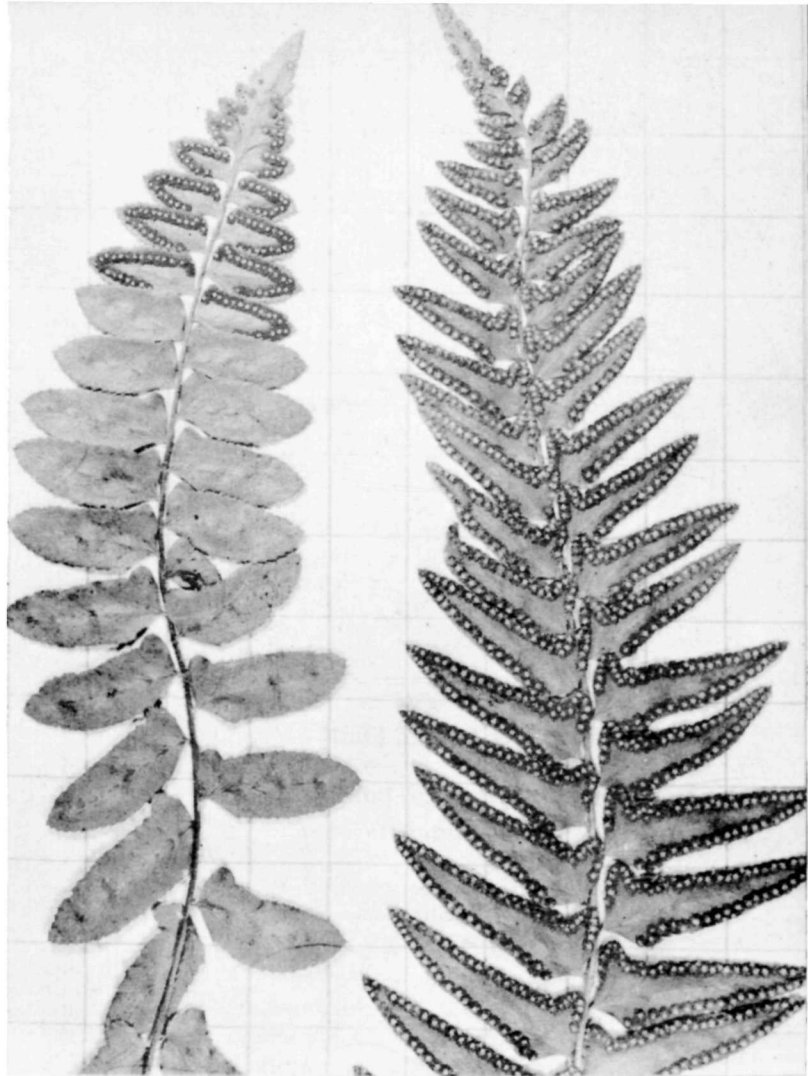


Fig. 40 SWORD FERN (*Polystichum munitum*). Upper: Many dark green shiny fronds arise from a short rhizome. Grows in open places on mountain sides. Lower L. to R: Pinnæ of SWORD FERN, IMBRICATED SWORD FERN (form *imbricans*), and NUDE SWORD FERN (form *nudatum*), showing circular indusium common to all varieties.

Fig. 41 Right: SWORD FERN (*Polystichum munitum*). On a fertile frond, sori commonly found on all pinnæ. Left: NUDE SWORD FERN (form *nudatum*). Sori commonly found on upper half of a fertile frond.



NUDE SWORD FERN

***Polystichum munitum* Presl. form
nudatum (D. C. Eat.) Broun
(Fig. 40, 41)**

P. munitum var. *nudatum*

Fronds 6 to 10 inches long, stalks with scales only at base. Pinnæ

scattered, only slightly lobed on upper side at base. Sori confined to upper half of the frond.

Found occasionally in the Sierra Nevada from Mariposa to Nevada Counties. May be observed on the 4-mile Trail to Glacier Point, and along Ledge Trail.

IMBRICATED SWORD FERN

***Polystichum munitum* Presl. form
imbricans (D. C. Eat.) Clute
(Fig. 40, 42)**

P. munitum var. *imbricans*

A small fern, usually not more than 15 inches high, stalk very chafy at base. The distinctive features of this variety are the crowded pinnæ which are imbricated or over-

lapping. Pinnæ are obliquely inclined upward. Sori occur only on the upper half of the fronds.

Known in the Sierra from Plumas County and Yosemite where it may be observed on any trails up the southern walls of Yosemite Valley, it always appears in drier places and may be an ecological variation. It is distributed from California to British Columbia.

PTERIDIUM

Brake Fern

BRACKEN or BRAKE FERN

Pteridium aquilinum var. *pubescens* Underw. (Fig. 43)

Pteris aquilinum

Pteris aquilinum var. *lanuginosum*

A single frond 2 to 4 feet high arises annually from the end of each branch of long black rhizomes. Fronds triangular in outline, much compounded. Sori continuous around leaf margins with rolled leaf margin serving as an indusium.

The rhizome was used in textiles and baskets by California Indians for its black color (Kroeber). The tender fronds were also eaten both raw and cooked by Miwok Indians (Godfrey).

This coarse fern is acid-loving and may be found in shady wooded areas, where fronds are usually widely scattered, or may grow in open meadows where plants are more likely to develop into dense stands. It is widely distributed, being known from Quebec and the Great Lakes Region to Alaska, in South Dakota, Texas and California.

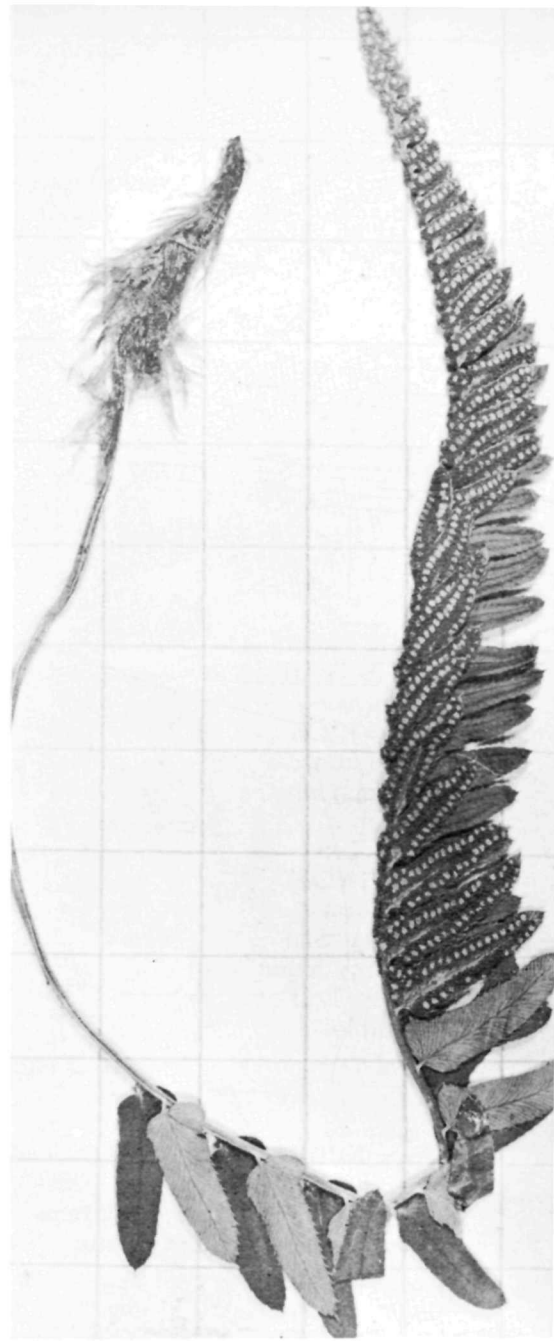


Fig. 42 IMBRICATED SWORD FERN (*Polystichum munitum* form *imbricans*). One frond showing the closely crowded pinnæ which overlap, and the scales at the base of the frond.

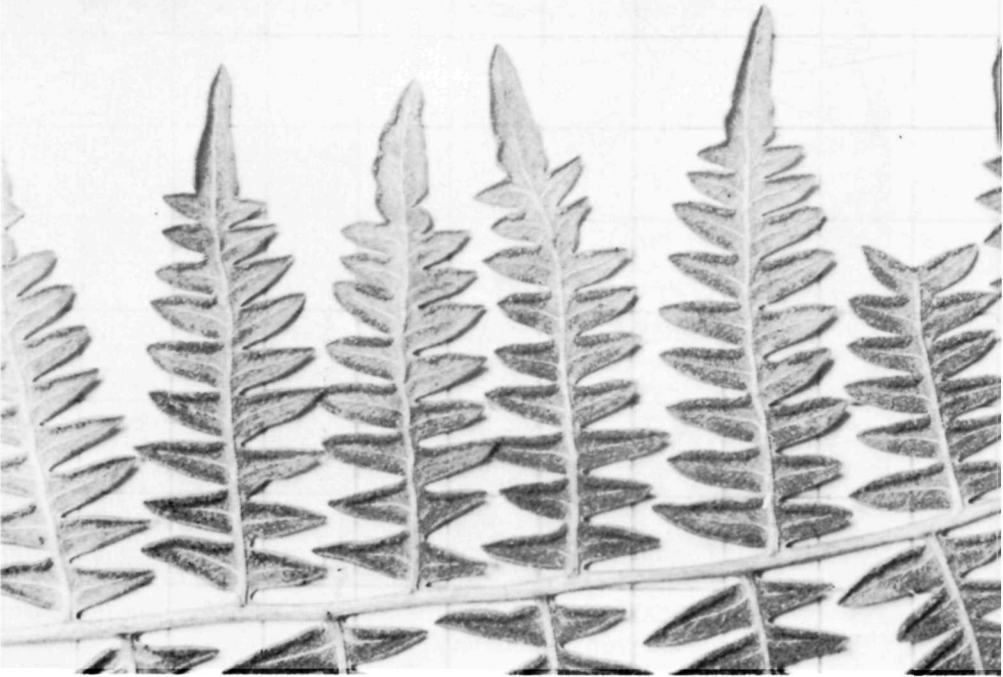


Fig. 43 BRAKE FERN (*Pteridium aquilinum* var. *pubescens*). Upper: One of our most common ferns in a wooded area. Also common in open meadows. Lower: Under side of one portion of a pinna with almost continuous marginal sori.

WOODSIA

Small dark-green ferns, bearing sori the whole length of the fronds. Round sori in a submarginal position borne on backs of free veins with a delicate cup-like indusium attached

under the sporangia. The indusium partly or entirely encloses the sporangia at first, often dividing early into irregular lobes, forming a fringe around the sporangia.

KEY TO THE SPECIES:

- Fronds with short hairs, glandular, divisions of the indusium narrow *W. scopulina*
 Fronds without hairs or glands, indusium fringed with hairs *W. oregana*



Fig. 44 Above: ROCKY MOUNTAIN WOODSIA (*Woodsia scopulina*). Grows in a cool canyon in moist soil.

Fig. 45 Right: ROCKY MOUNTAIN WOODSIA (*Woodsia scopulina*). Upper left: Lower side of a frond with its circular sub-marginal sori. Upper right: Top of one frond covered with short hairs. Lower left: Cup-like indusium attached beneath the sporangia of this species. Lower right: One fringed indusium beneath the sporangia from OREGON WOODSIA (*Woodsia oregana*).

ROCKY MOUNTAIN WOODSIA

***Woodsia scopulina* D. C. Eat.**
(Fig. 44, 45)

Clusters of fronds 5 to 10 inches high with lower part of stalk dark brown, having a few scales. Dark green fronds broadly lanceolate, covered with scattered multi-cellular or glandular hairs, usually bi-pinnate, or pinnate with segments deeply cut and toothed. Sori submarginal, indusium delicate, cup-like, divided into narrow divisions, ending in hairs (Fig. 45).

This fern closely resembles *Cystopteris fragilis* in size and general appearance. Both grow in moist places along streams. In *Woodsia* fronds are darker green, slightly curled down around the margins and sporangia are green when young, light brown when mature and after spores are shed. Young sporangia in *Cystopteris* are black; older sporangia appear brown after their spores are shed.

Although this fern is found in the Rocky Mountains, as its common name implies, and is widely distributed as far north as Alaska, south to Tennessee, Oklahoma and North Carolina, and around the Great Lakes, it is only known from a few places in the Sierra Nevada at elevations from 4,000 to 9,000 feet including Ouzel Basin and Hamilton Lake area in Sequoia National Park and from Mono Pass and the Ledge Trail in Yosemite. It has been found as far north in the Sierra as the Modoc Lava Beds.

OREGON WOODSIA

***Woodsia oregana* D. C. Eat.**
(Fig. 45, 46)

Very similar to Rocky Mountain *Woodsia* in general size and shape



WOODWARDIA

GIANT CHAIN FERN

Woodwardia fimbriata Sm. (Fig. 47 and cover)

W. chamissoi

W. radicans as given by Jepson is a
mis-identification

Fronds from 3 to 6 or even 8 feet high, pinnae 4 to 18 inches long, broadly lanceolate in outline and pinnately cut almost to the midrib; segments minutely toothed, somewhat scalloped. Sori oblong-linear in cavities, in a chain on each side of the midvein of the segments. Indusium fixed by its outer margin and hinged to open and allow spores to be disseminated.

Indians in the Sierra are reported by Kroeber to have used the fibers from this fern dyed red with alder bark for basket and textile designs.

The largest and most magnificent of our ferns, the Giant Chain Fern, is widely distributed throughout California in the Coast Range and Sierra, although never considered common. It always occurs where there is constant seepage, such as Big Fern Creek, and several places along the Kaweah River in Sequoia National Park; along the Merced River a few miles below El Portal, near Cascade Falls, and across the footpath at Happy Isles, Yosemite. Known from British Columbia to California.

Hall reported a dwarf form from several points in Yosemite Valley. The author transplanted this form into the San Joaquin Valley 12 years ago and it now has fronds 3 feet long, which is considerably larger than the dwarf in Yosemite, but it has not grown to the size of the large form from the Sierra.



Fig. 46 OREGON WOODSIA
(*Woodsia oregana*). One frond
showing the sori in submarginal positions.

of fronds and location of sori. Here fronds are glabrous, free from any glands or pubescence. The indusium seated under the sporangium has hair-like lobes, which in young sporangia reflex upward, and appear to enclose the sporangia (Fig. 45).

Found from 4,000 to 5,000 feet elevation at a few places from San Bernardino County northward into Washington. Not common in the Sierra. This species closely resembles *Cystopteris* as noted in the above species. It is found from Lower California to British Columbia, in Quebec, Oklahoma, and New Mexico.

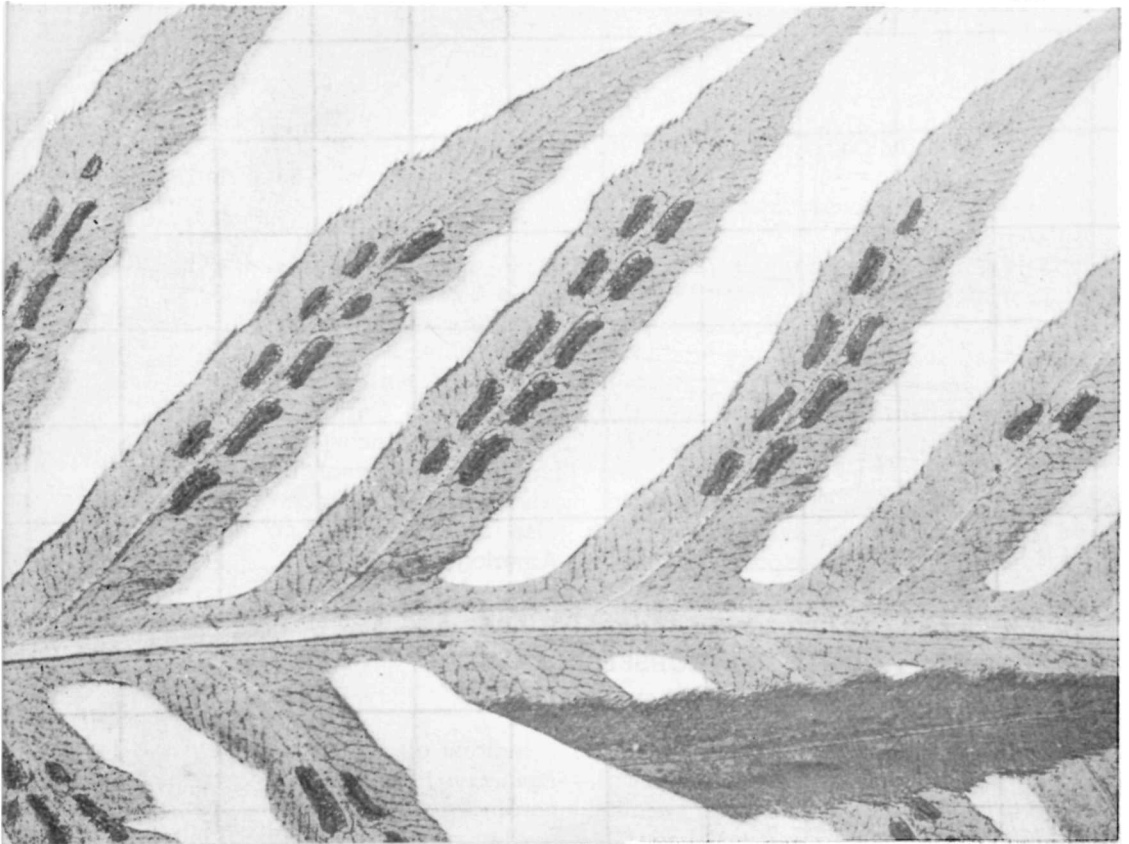


Fig. 47 GIANT CHAIN FERN
(*Woodwardia fimbriata*).
Upper: Portion of one
deeply lobed pinna
with its oblong sori.
Lower: This largest of
our native ferns must
live in seepage areas,
usually in partial
shade.

SALVINIACEAE
SALVINIA FAMILY

DUCKWEED FERN

Azolla filiculoides Lam. (Fig. 48)

Small floating aquatic plants ¼ to 1 inch long which branch pinnately and bear crowded overlapping 2-lobed leaves on the upper side of the stems, a few roots on the lower side. Spores are contained within a special structure called a SPOROCARP, submerged in water on lower side of the stem. Two or more sporocarps may occur on one branch, each containing 1 megaspore or micro-

spores.

Sometimes called the Fern-like Azolla, these moss-like plants are green or dark red, often occurring in masses that cover ponds or pools of quiet water. Widely scattered among the western states, in lower elevations in California in the Sierras at such places as Three Rivers, La Grange, Mormon Bar near Mariposa, north to Modoc. The species also occurs in Mexico and South America.

EQUISETACEAE
HORSETAIL FAMILY

EQUISETUM

Erect plants arising from a black perennial branching rhizome. Stems hollow except at nodes, with sheaths at nodes. Sheaths represent whorls of fused leaves. Fertile stems terminate in a cone which bears sporangia. It is advisable to identify these plants from fresh material since artifacts are sometimes produced which would provide misleading results in keying. For example, the collar or sheath which is tight around the stem in fresh material of some species may not shrink as much as the stem in drying, and thus appears flared, a characteristic of a different species.

Indians of central California used *Equisetum* to polish their arrows, according to Kroeber. The abrasive quality of the stems due to silicates in the cell walls was well known by early white settlers in the west who used them to clean household utensils, hence the name "scouring rush" applied to some species by the pioneers. This abrasive is also said to cause death in sheep and cattle as a result of internal hemorrhage. A number of species of *Equisetum* have been used medicinally as herbs. They contain aconitic acid and are used as diuretics.

KEY TO THE SPECIES:

- Two kinds of stalks: sterile with whorls of branches, and unbranched fertile ones with terminal cone *E. arvense*
- Only one kind of stalk, eventually bearing cones
 - Cones pointed at apex
 - Sheath at nodes closely pressed to stem, stems rough to touch *E. biemale*
 - Sheath flared at nodes, stems smooth to touch *E. laevigatum*
 - Cones rounded at apex *E. kansanum*

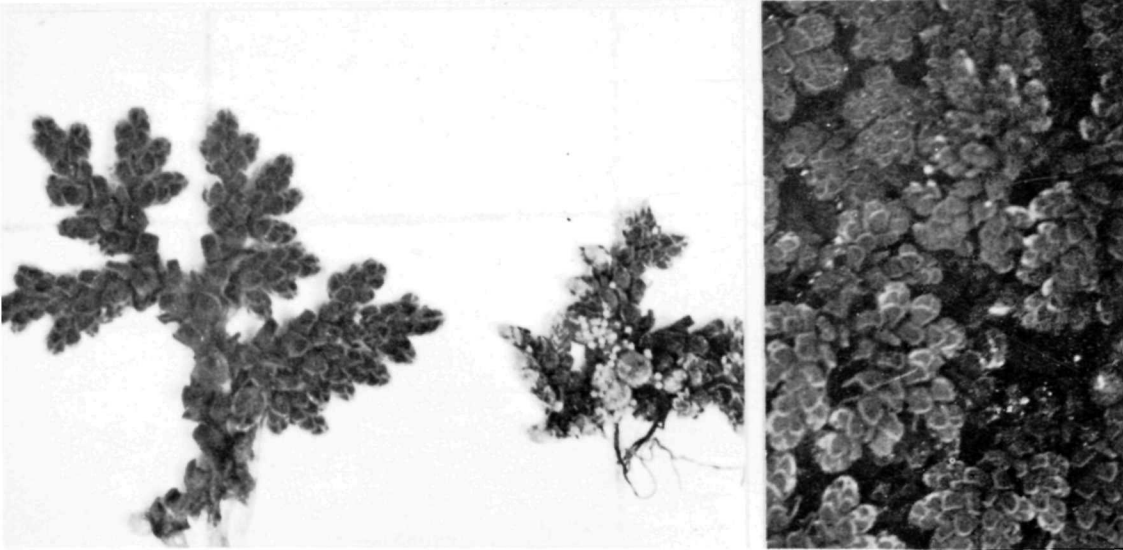


Fig. 48 DUCKWEED FERN (*Azolla filiculoides*). Upper: This small fern can be found floating in sluggish streams of foothills. Lower left: Top view (left) of one branched plant and bottom view (right) showing two sporangia and microspores. Lower right: Close view of a mass of this fern in its normal habitat.

COMMON HORSETAIL

Equisetum arvense L. (Fig. 49, 50)

Sterile stems $\frac{1}{2}$ to 2 feet high, slender, 10-15 furrows, nodal sheath loose, ending in about 12 brown teeth. Whorls of branches numerous, jointed as in the stems with only 4

teeth on each sheath. Fertile stems 4 to 7 inches high having 3 to 5 nodes with long, loose sheaths, often brown, and a terminal spore-producing cone 1 to $1\frac{1}{2}$ inches long. Fertile stems appear very early in the spring and are rarely seen because after a few days they shed their

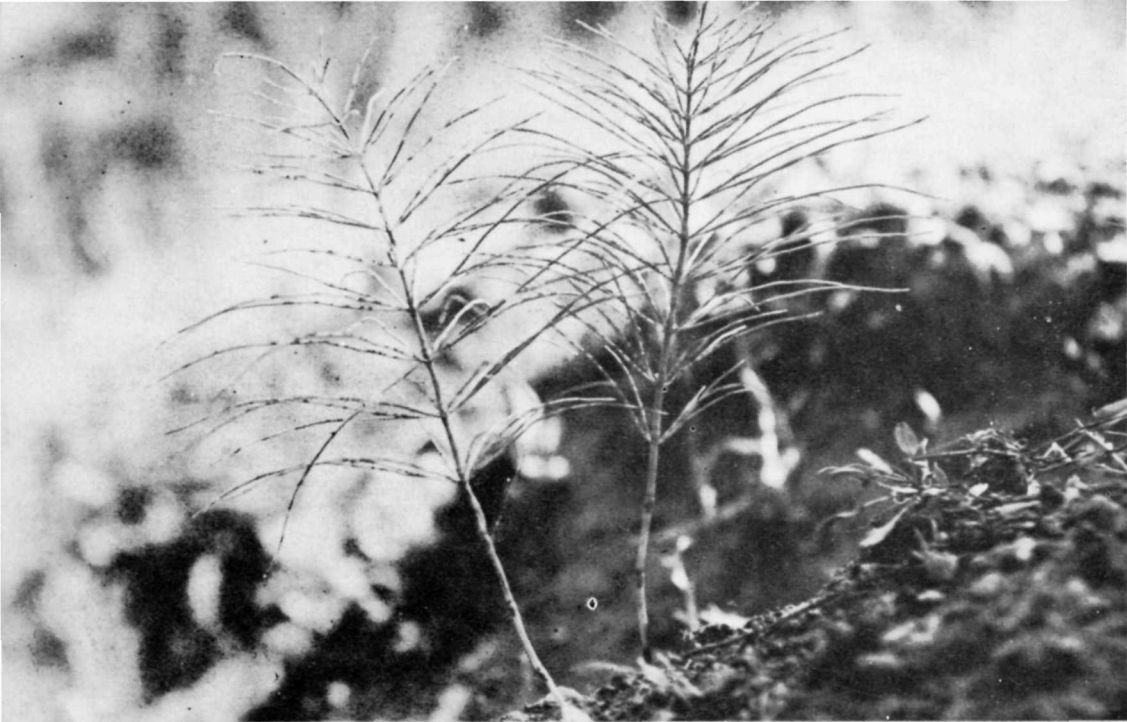


Fig. 49 COMMON HORSETAIL (*Equisetum arvense*). Upper: Growing on a sandy stream bank. Sterile branches only. Lower: COMMON SCOURING RUSH (*Equisetum hiemale*). Growing as a dense stand in both open sunlight and in shade.

spores and die down. The sterile stalks remain for the whole season.

Common in sandy wet soil in or near streams or swamps 2,000 to 9,000 feet elevation in the Sierra Nevada. Also known from the arctic, Europe, Asia, and northern Africa.

COMMON SCOURING RUSH

Equisetum hiemale L. var.
californicum Milde. (Fig. 49, 51)

Stout evergreen stems 2 to 4 feet high, rough to touch, simple or rarely branched, branches usually bearing cones. Whorls of sterile branches not present at the nodes. Long brown teeth on the sheath at the nodes are deciduous early in the season, leaving a smooth rim to the sheath. The sheath nearly or quite as broad as long, close to the stem, never flared from it. Color characteristics of the sheaths variable in the species, but basically gray in color. In younger stems one upper black ring present; in older stems an upper and a lower black ring usually visible. The ovate cones are $\frac{1}{2}$ to $1\frac{1}{2}$ inches long, yellow or black, pointed at apex.

Also known as the Western Scouring Rush and the Rough Scouring Rush. The rhizomes may extend a great distance underground. One rhizome, which the author traced, extended 6 feet from the nearest vertical stem on the same plant. This species grows in the Coast Range and Sierra Nevada from 2,000 to 5,000 feet elevation along sandy stream banks sometimes in very dense stands. Known in Alaska, Utah and California.

SMOOTH SCOURING RUSH

Equisetum laevigatum A. Br.
(Fig. 51)

Similar in general appearance to *E. hiemale*, but the stems here usually

smaller, always smooth to touch. Evergreen stems 1 to 2 feet high,



Fig. 50 COMMON HORSETAIL (*Equisetum arvense*). Left: A sterile branched stalk, the one most commonly observed. Right: Fertile stalk with its terminal cone and loose sheath-like collar at nodes.

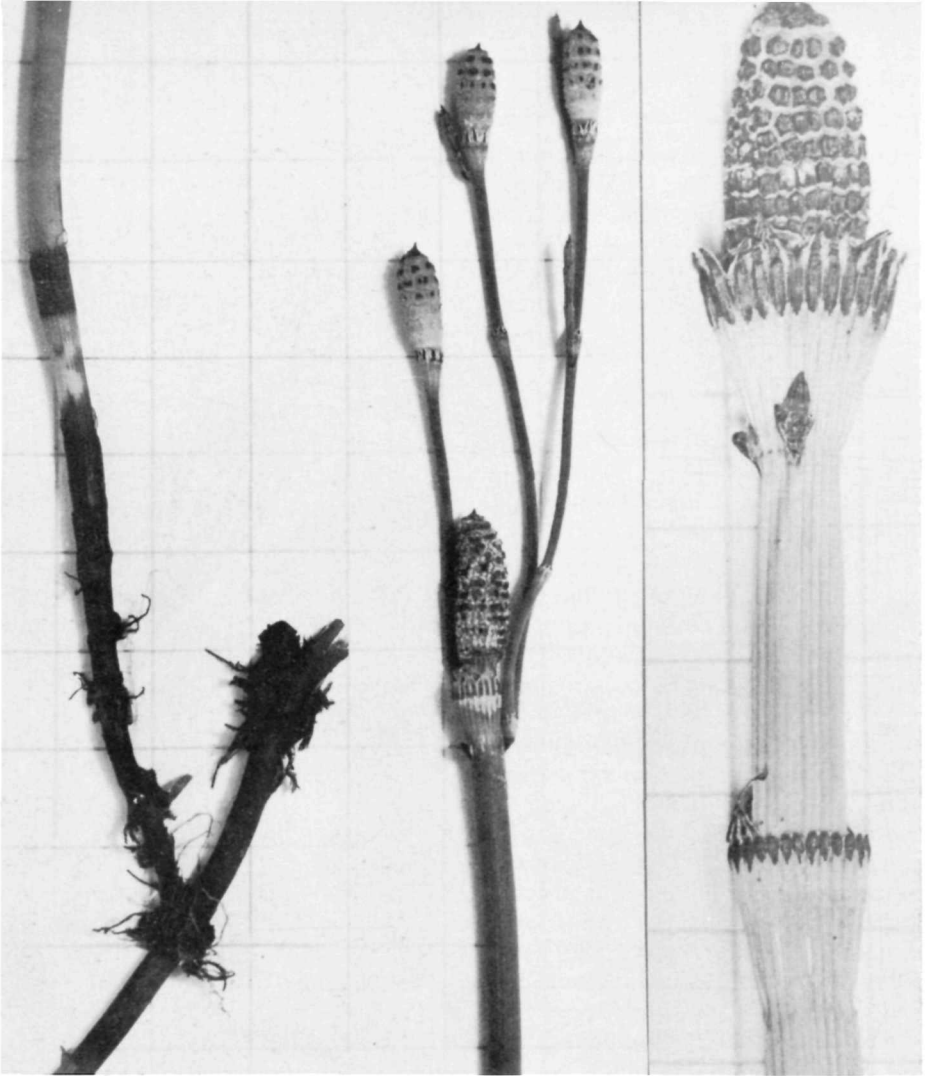


Fig. 51 COMMON SCOURING RUSH (*Equisetum hiemale*). Left: Base including one upright stem and a portion of the long rhizome. Solid black portions grow underground. Center: Top of same plant including cones and branches. Right: SMOOTH SCOURING RUSH (*Equisetum laevigatum*). Fertile branch with pointed cone and flared sheaths at nodes.

usually unbranched, pale green. Sheath longer than broad, flaring open, teeth of the sheath deciduous, resulting in a smooth border to the sheath when they fall. Cones $\frac{1}{2}$ to 1 inch long borne at the ends of the stems.

Sometimes called Braun's Scouring Rush. This species is found in

the Sierra Nevada at such places as Granite Creek and Round Meadow in Sequoia National Park, along the Merced River in Yosemite Valley and northward to British Columbia, eastward to the Great Lakes, Massachusetts, Virginia and Georgia, southward to Mexico and Guatemala.

KANSAS SCOURING RUSH

Equisetum kansanum Schaffner (Fig. 52)

Similar in appearance to *E. laevigatum* because the sheath flares open. This species is not evergreen and the cone is rounded at its tip.

Also known as the Kansas Horse-tail. Least common of the species found in the Sierra, it has been collected by Carl Sharsmith near Arch Rock, Yosemite. It is reported from Howells, Sequoia National Park and is known in a few widely scattered areas from Ohio westward to British Columbia and in Texas.

SELAGINELLACEAE SELAGINELLA FAMILY SELAGINELLA

Low creeping branching herbaceous plants, usually on soil, having the appearance of moss. Stems covered with small uniform leaves which overlap. Leaves spirally attached to the stem. Reproduction by spores borne in cones, the cones usually quadrangular whereas the vegetative stems are not quadrangular but cylindrical.

The vegetative leaves and spore bearing leaves are rather similar in appearance. Cones, therefore, resemble portions of a leafy stem. For this reason, and because cones are not borne on stalks, one must examine a plant carefully in order to see them. Cones produce two types of spores: microspores, small, numerous, usually red or orange, and megaspores, 4 per sporangium, frequently yellow. Margins of leaves and sporophylls may bear hair-like cilia, and the leaf apex often terminates in a seta, a soft bristle, white or transparent.

The only genus in the family, it is

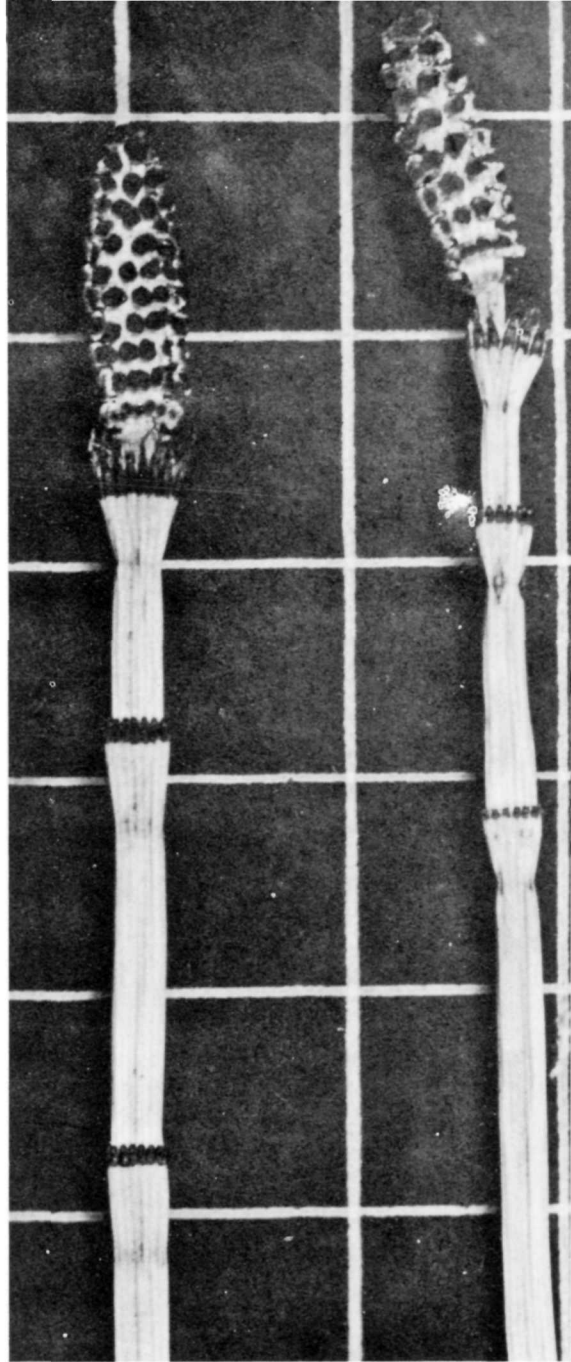


Fig. 52 KANSAS SCOURING RUSH (*Equisetum kansanum*). Fertile branch with rounded cone and flared sheaths at nodes.

widely distributed throughout the world, and is more common in the tropics and places of high rainfall. Species from Texas and other areas may be bought in variety stores as the Resurrection Plant, which appear dead and are tightly curled, but if

put into a saucer of water overnight, they open and become bright green. Our species are not usually suitable for gardens or as potted house plants. They will stay for short periods if kept in moist soil. Invert a quart jar over them for best results.

KEY TO THE SPECIES:

- Branches somewhat dorsiventral, leaves of the under ranks largest, obliquely imbricate, foothills to 6000 feet elevation*S. hansenii*
 Branches not dorsiventral, leaves uniform, equally distributed on all sides, 8,000 to 11,000 feet elevation*S. watsonii*

HANSEN'S SELAGINELLA

Selaginella hansenii Hieron. (Fig. 53)

S. ruprestris var. *hansenii*

Prostrate stems 2 to 10 inches long, stems branch once, rarely 2 or 3 times, strongly dorsiventral with leaves obliquely imbricate. Leaves lanceolate, terminating in a seta which is about 1/32 inch long, white to transparent. Leaf margins are lined with 6 to 18 cilia on each side. In cones the sporophylls broader

than leaves, almost triangular, with sporangia attached at the base, megasporos yellow, microspores orange.

Forms mats on rocky places at lower elevations in the Sierra Nevada from 1,000 to 6,000 feet elevation. Common in the foothills, this species may be observed at the base of the cliffs on the talus slope on the north side of Yosemite Valley. It extends from Fresno County to Mount Shasta.

ALPINE SELAGINELLA

Selaginella watsonii Underw. (Fig. 53)

Creeping stems 1 to 12 inches long with a few short branches that form mats. Lanceolate leaves are of equal length on upper and lower sides of the stem. Each leaf has as many as 9 cilia or none, ending with a short, greenish-yellow seta. Cones quadrangular 1/2 to 1 inch long in which sporophylls resemble leaves

except that sporophylls are broader, almost triangular.

Although this species has on rare occasions been found at 6,000 feet elevation, it is usually found from 10,000 to 13,000 feet. Known from alpine regions on some of the higher mountains in the Sierra from such places as Fairview Dome, Snow Mountain, Mt. Lyell Cirque, and Kuna Crest in Yosemite. It was first collected in Utah and has also been recorded from Nevada, Oregon, and Montana.



Fig. 53 HANSEN'S SELAGINELLA (*Selaginella hansenii*). Upper: Found at low elevations. White arrows point to quadrangular cones. Lower: ALPINE SELAGINELLA (*Selaginella watsonii*). Growing in cracks of mica shist rocks above 10,000 feet elevation.



ISOETACEAE
QUILLWORT FAMILY

ISOETES

Perennial plants either submerged, amphibious or terrestrial. Stem forms a condensed 2 or 3-lobed corm; numerous roots branch dichotomously. Leaves are broad at base, tapering to an awl-like apex, 3 or 4-angled in cross-section appearing hollow, but actually having 4 longitudinal rows of air chambers. Many leaves, ultimately becoming sporophylls which bear microspores or megaspores on their inner side at the base of the leaf. Sporangia, flattened on one side, are never larger than about $\frac{1}{8}$ inch in diameter and may or may

not be covered with a membrane called a velum. According to Frye, one microsporangium produces 150,000 to 300,000 microspores and one megasporangium produces 150 to 300 megaspores. One leaf will bear only one of these kinds of spores. The sculpturing of the sporangia walls by various spines, ridges and reticulations is important in the classification of the species.

This is the only genus in the family and contains about 60 species with worldwide distribution according to Abrams.

KEY TO THE SPECIES:

Submerged aquatic, 2-lobed corm *I. bolanderi*
Terrestrial in damp places, 3-lobed corm *I. nuttallii*

BOLANDER'S QUILLWORT

***Isoetes bolanderi* Englm. (Fig. 54, 55)**

Corm 2-lobed, 5 to 20 leaves, 2 to 6 inches long, tapering like a quill, hence the common name. Megaspores marked with minute spines and wrinkles, microspores spiny.

In shallow ponds and lakes from 5,000 to 10,000 feet elevation in the Sierra Nevada including such places as Siesta Lake, Dog Lake, and ponds in many meadows in Yosemite. It is also known from British Columbia to Wyoming, in Colorado, and Arizona.

NUTTALL'S QUILLWORT

***Isoetes nuttallii* A. Br. (Fig. 55)**

Corm 3-lobed, 15 to 60 leaves per plant, leaves 3 or 4 inches long, slender. Megaspores variable in size, smooth or warty; microspores brown, covered with spinelike papillae.

A terrestrial species found on the banks of streams, or more common in the Sierras in shallow soil under the mist of waterfalls. Distributed throughout California, Oregon, Washington, Idaho, and Lower California.

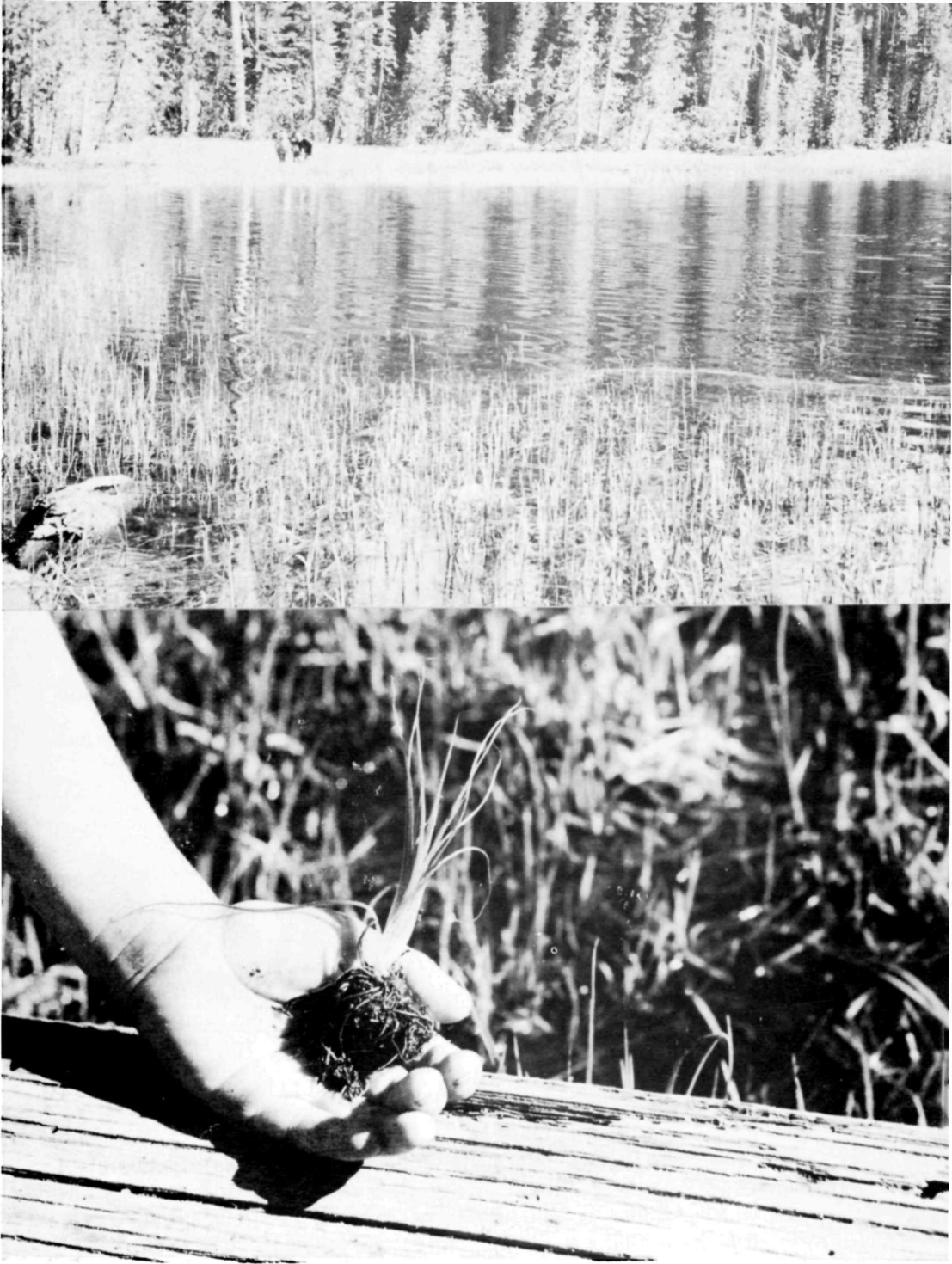


Fig. 54 BOLANDER'S QUILLWORT (*Isoetes bolanderi*). Upper: Growing in a typical shallow lake of the Sierra where water is no deeper than four feet. Lower: Close-up of this species from the above lake.

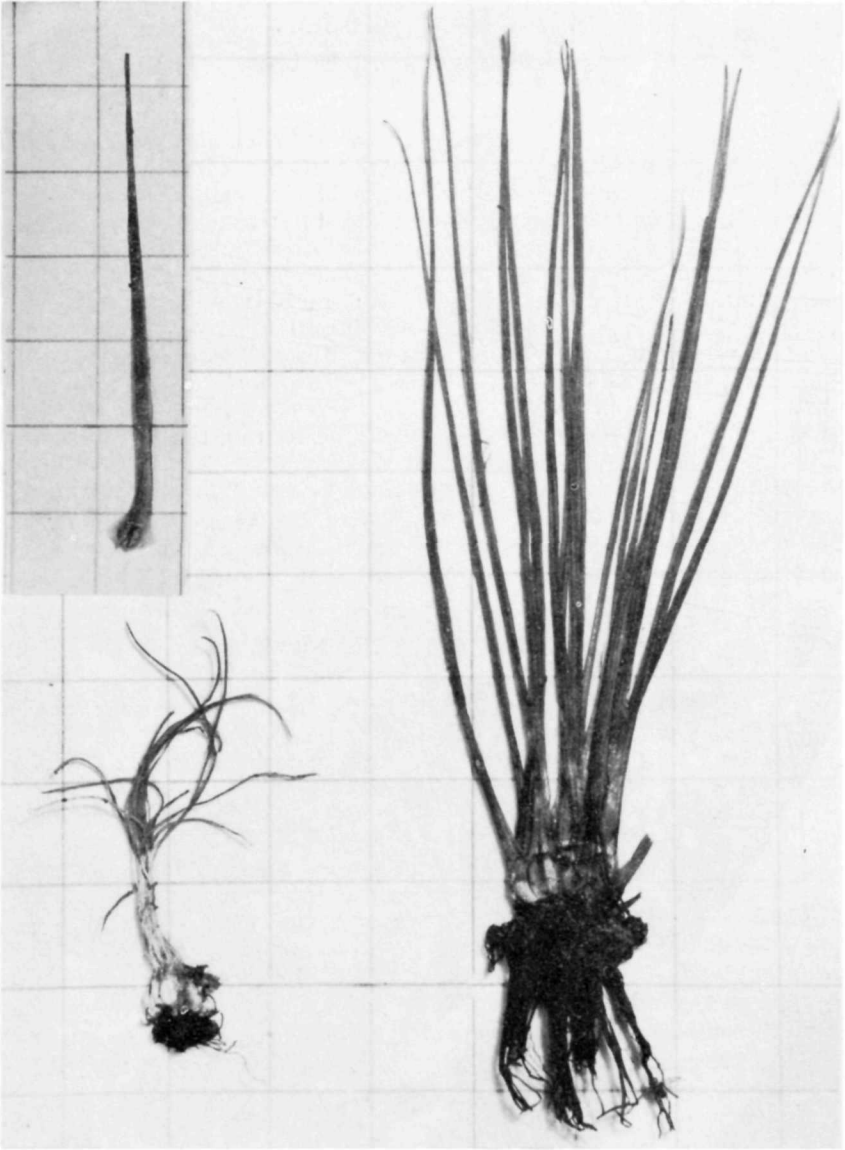


Fig. 55 Lower left: NUTTALL'S QUILLWORT (*Isoetes nuttallii*). 'Swollen leaf bases contain sporangia. This species grows in the mist of waterfalls with its roots in soil. Right: BOLANDER'S QUILLWORT (*Isoetes bolanderi*). Showing comparative size to the first species. Upper insert: One leaf or sporophyll of the latter species with its sporangium at the base.

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INDEX
(Illustrations in Bold Face Type)

- A**
- Acknowledgements 48
- Adder's Tongue Family 62
- Adiantum 66
- capillus-veneris* **67**, 68
- emarginatum* * 68
- jordanii* 68, **69**
- pedatum* **66**, **67**, 68
- pedatum aleuticum* * 68
- Alpine Selaginella 115
- American Rock Brake* 80
- Annularia 61
- Aspidium rigidum argutum* 83
- Athyrium 70
- alpestre americanum* 70, **72**
- americanum* * 70
- filix-femina* 70, **71**
- filix-femina californicum* * 70
- Azolla filiculoides 109, **110**
- B**
- Bolander's Quillwort 117, **118**, **119**
- Botrychium 62
- multifidum coulteri* 64, **65**
- simplex* 62, **63**
- silicifolium* * 64
- Brewer's Cliff Brake **89**, 89
- Bridges' Cliff Brake **90**, 90
- C**
- Cheilanthes 73
- californica* **73**, 76
- cooperae* **75**, 77
- covillei* **76**, **77**, 78
- gracillima* **78**, **79**, 79
- siliquosa* **74**, 76
- Contents 45
- Cryptogramma 80
- acrostichoides* * 80
- crispa acrostichoides* 80, **80**, **81**
- Cystopteris 83
- fragilis* **82**, 83
- D**
- Dryopteris 83
- arguta* 83, **84**, **85**
- Desert Cliff Brake 92, **94**
- E**
- Equisetaceae 109
- Equisetum 109
- arvense* 110, **111**, **112**
- hiemale californicum* **111**, 112, **113**
- kansanum* 114, **114**
- laevigatum* 112, **113**
- F**
- Fern allies, Story of 57
- Fern
- American Rock Brake* 80
- Alpine Lady 70, **72**
- Bead **76**, **77**, 78
- Bird's Foot **91**, 92, **93**
- Black* 92
- Brake 103, **104**
- Bracken 103, **104**
- Brewer's Cliff Brake 89, **89**
- Bridge's Cliff Brake 90, **90**
- Brittle* 83
- California Lace **73**, 76
- California Wood 83, **84**, **85**
- Coastal Wood Fern* 84
- Coffee **87**, 88
- Cooper **75**, 77
- Coville's Lip* 78
- Desert Cliff Brake 92, **94**
- Duckweed 109, **110**
- Five Finger **66**, **67**, 68
- Fragile **82**, 83
- Giant Chain 107, **108**, and **Cover**
- Gold Back* 94
- Gold 94, **95**
- Golden Polypody 99, **99**, **100**
- Grape 62
- Indian's Dream **74**, 76
- Lace **78**, 79, **79**
- Lady 70, **71**
- Leathery Grape 64, **65**
- Licorice 97, **98**
- Little Grape 62, **63**
- Maiden Hair
- California 68, **69**
- Common **67**, 68
- Oregon Woodsia 106, **106**, **107**
- Parsley 80, **80**, **81**
- Poison* 92
- Polypody 96
- Rocky Mt. Woodsia **105**, 106, **106**
- Sheep* 88
- Sierra Cliff Brake 88, **88**, 89
- Simple Grape Fern* 62

*Synonyms or non-valid species for our area.

INDEX (continued)

- Stamp* 94
 Sword 100, **101**, **102**
 Imbricated **101**, 102, **103**
 Nude **101**, 102, **102**
 Tea* 92
 White 95, **96**, **97**
 Fern family 64
 Ferns, Life History of 49, **51**
 Fern-like *Azolla** 109
*Filix fragilis** 83
 Fossils, of fern **50**, **54**
 of fern allies **59**, **61**
- G**
- GLOSSARY 53, **55**
 Golden Polypody 99, **99**, **100**
*Gymnogramme triangularis** 94
- H**
- Hansen's *Selaginella* 115
 Horsetail 109
 Common 110, **111**, **112**
 Kansas* 114
 Horsetail family 109
- I**
- Illustrations, List of 45
 Indian's Dream **74**, 76
 Introduction 47
 Isoetaceae 117
 Isoetes 117
 bolanderi 117, **118**, **119**
 nuttallii 117, **119**
- K**
- Key to the fern genera 60
- L**
- Lycopodium* 58
- N**
- Nuttall's Quillwort 117, **119**
- O**
- Ophioglossaceae 62
 Oregon Woodsia 106, **106**, **107**
- P**
- Pellaea* 86
 andromedaefolia **87**, 88
 brachyptera **88**, 88
 breweri **89**, 89
 bridgesii **90**, 90
 *compacta** 92
 *densa** 76
 *mucronata** 92
 mucronata californica 92, **94**
 mucronata mucronata ... **91**, 92, **93**
 *ornithopus** 92
 *wrightiana compacta** 92
*Phegopteris alpestris** 70
 *alpestris americanum** 70
Pityrogramma 94
 triangularis 94, **95**
 triangularis pallida 95, **96**, **97**
 Polypodiaceae 64
 Polypodium 96
 *californicum** 97
 *fragile** 83
 *hesperium** 99
 *virginianum** 99
 vulgare columbianum ..99, **99**, **100**
 *vulgare intermedium** 97
 vulgare kaulfussii 97, **98**
 Polypody 96
 Polystichum 100
 munitum 100, **101**, **102**
 munitum form
 imbricans **101**, 102, **103**
 munitum var. *imbricans** 102
 munitum form
 nudatum **101**, 102, **102**
 munitum var. *nudatum** 102
Pteridium aquilinum
 pubescens 103, **104**
*Pteris aquilinum** 103
Pteris aquilinum
 *lanuginosum** 103
- Q**
- Quillwort 117
 Bolander's 117, **118**, **119**
 Nuttall's 117, **119**
 Quillwort family 117
- R**
- References 120
 Rocky Mountain
 Woodsia **105**, 106, **106**
- S**
- Salviniaceae 109
Salvinia family 109

INDEX (continued)

Scouring Rush		Hansen's	115
Braun's*	113	ruprestris hansenii*	115
Common	111, 112, 113	watsonii	115
Kansas	114, 114	Sierra Cliff Brake	88, 88
Rough*	112		
Smooth	112, 113	W	
Western*	112	Woodsia	105
Selaginellaceae	114	oregana	106, 106, 107
Selaginella family	114	scopulina	105, 106, 106
Selaginella	114	Woodwardia	107
Alpine	115, 116	chamissoi*	107
hansenii	115, 116	fimbriata	107, 108 and Cover
		radicans*	107

*Synonyms or non-valid species for our area.

