BRITISH · FERNS CLUB · MOSSES AND · HORSETAILS

PEEPS · AT · NATURE

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EDITED BY
THE REV. CHARLES A. HALL, F.R.M.S.

IV—BRITISH FERNS, CLUBMOSSES, AND HORSETAILS

IN THE SAME SERIES

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BRITISH FERNS, CLUBMOSSES, & HORSETAILS

BY

DANIEL FERGUSON, M.A.

CONTAINING 23 ILLUSTRATIONS, VIZ. :
8 FULL PAGES IN COLOUR AND
11 PICTURES IN BLACK AND WHITE FROM PHOTOGRAPHS
AND 4 IN THE TEXT FROM DRAWINGS

LONDON
ADAM AND CHARLES BLACK
1912

INTRODUCTORY EDITORIAL NOTE

I LOOK upon this little volume as a distinct acquisition to the "Peeps at Nature" Series, and I am confident that it will receive a kindly reception on the part of those who desire a well-illustrated, reliable, and at the same time inexpensive, book on ferns and their allies. The author has packed a great deal of information in a small space; he has dealt with a difficult subject in a simple way. As a practical field botanist and close observer, he is well acquainted with the difficulties of identification, and the following chapters are the result of experience. The book will be valued by the general Nature student as well as the young beginner.

The author has dealt with all ferns and their allies regarded by Sir J. D. Hooker as definite British species, with two exceptions: (1) A Fern, *Gymnogramme leptophylla;* and (2) a Quillwort, *Isoetes Hystrix.* These two plants are British only in a political sense, being restricted to the Channel Islands.

CHARLES A. HALL.

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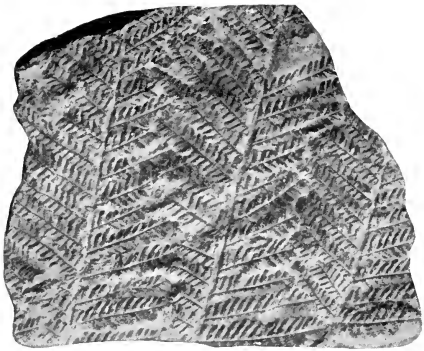
LIST OF ILLUSTRATIONS

ALSO 4 LINE DRAWINGS IN THE TEXT.

* *These illustrations are in colour; the remainder are in black and white from photographs.*

PLATE 2

(1)



(2)

(1) Fossil Fern Frond. (*From Scott's "Structural Botany"*)

(2) Maidenhair Spleenwort Fern

BRITISH FERNS, CLUBMOSSES, AND HORSETAILS

CHAPTER I

PAST HISTORY

"Here about the beach I wandered, nourishing a youth sublime
With the fairy tales of science and the long result of Time."
TENNYSON.

To every boy and girl who falls in early years under the spell of the fairy tales of childhood there comes a time, sooner or later, when the doings of giants and fairy godmothers, the secrets of enchanted castles, and the wondrous powers of magic carpets, cease to charm. Happy are they who at this time have their thoughts directed to those greater marvels of which the poet sings, "the fairy tales of science and the long result of Time."

In the first volume of this series, entitled "Wild Flowers and their Wonderful Ways," the fairy tale which Science has revealed in the lives of plants is unfolded, and what an entrancing tale it is! But we may not retell it here. Rather have we to deal with

one of the long results of Time, as ferns and those strange relatives of theirs, clubmosses and horsetails, have been proved to be the descendants of plants that grew millions of years ago.

Let us try to picture what the world was like at that very remote period. Large tracts of the land surface of the globe then consisted of dense swamps, intersected by slow-flowing rivers on their way to the seas. So great was the heat that moisture in the form of vapour was continually rising from the surface of the swamps, rivers, and seas. The thick clouds of mist thus formed acted as a screen between the blazing sun and the earth.

Under such conditions of heat, moisture, and shade, the plant life of the period was of extraordinary luxuriance. Dense forests with trees of gigantic size, far exceeding in height the monarchs of our present-day British woods, and a close tangled undergrowth of many smaller forms of vegetation covered the muddy swamps. Six great groups of plants are known to have inhabited these dense forests, but only three out of the six—namely, ferns, clubmosses, and horsetails—are represented among British plants to-day. Till a few years ago ferns were regarded as one of the most important of these ancient groups. Recent research, however, has shown that this view must be greatly modified. Many of the plants hitherto looked upon as true ferns have been shown not to have been so in reality. While they resembled true ferns very closely

in their foliage, they differed from the latter in their fruits—a very important distinction, as will appear later. In view of these discoveries we can no longer look upon true ferns as either the most abundant or the most characteristic plants of the period. Still, it is not disputed that this group of plants—namely, true ferns—then attained a luxuriance of which their modern representatives, the ferns of our countryside, with the possible exception of the sturdy bracken, bear little or no traces.

Like the ferns, the British clubmosses and horsetails of to-day give little indication that they are the descendants of plants which at one time literally overshadowed the earth.

The ancient clubmosses were gigantic plants, often 60 feet or more in height. Their stems were thickly clad with leaves, arranged sometimes spirally and sometimes in vertical rows. Our modern British clubmosses, on the other hand, are very insignificant both in size and number. Like their ancestors, they have their stems thickly clothed with leaves, but the leaves are never more than a quarter of an inch in length.

With a superficial resemblance to true mosses they creep almost unseen and unrecognised along the heather-clad slopes of our hills and mountains.

Horsetails, or paddockpipes, as they are called by farmers and others, are those strange plants with cylindrical and frequently fluted stems, conelike heads, and whorls or circles of leaves with well-marked nodes

(points on the stem from which the leaves spring), which so puzzle the young student of Nature when he takes his walks abroad. But while the tallest of our present-day native horsetails seldom exceeds 5 feet in height, the ancient horsetails were tall trees, rivalling in height and abundance the clubmosses of the period. Like their descendants, they, too, possessed cylindrical stems, leaves in whorls, and distinctly marked nodes.

Now, it must not be imagined that these ancient groups of plants, the ancestors of the British ferns, clubmosses, and horsetails of to-day, were similar in every detail to the now-existing species. Consider the vast period of time, millions of years, which separates us from the age when these ancient ferns and their relatives flourished, and all the changes which the world has undergone since then. Such changes, scientists are always reminding us, are one of the chief causes of the variations or modifications which have taken place during the course of the ages in plants and animals. Therefore it is not to be wondered at if our modern ferns and their allies show many points of divergence from the ancient types. To these changes which completely altered the face of the earth we can only make a very brief reference. Geologists believe that the land must have sunk beneath the seas and buried the then existing vegetation under huge masses of sand and mud. How many of these sinkings and buryings took place we need not dwell on here, but we must take notice of the results

which followed, for the coal which we find so useful to-day is composed of the buried trunks, branches, leaves, and seeds of the plants which grew during this bygone age. The pressure of the overlying deposits of mud and sand hardened the vegetable remains into a solid mass, which, altered by chemical changes, was finally transformed into coal.

The subsequent changes which again altered the earth's crust and finally moulded it into its present form produced conditions under which these ancient plants found it difficult to maintain their position in the plant world. Some died out completely, while others, as we have seen, lingered on, though in a very degenerate form. Could we have lived under the conditions which prevailed at that remote period, and have seen the fern alliance in all its glory, and then have slept, Rip Van Winkle-like, through the vast intervening cycle of years, how great would be our astonishment on awakening to behold how the former things had passed away! How difficult it would be to persuade us that the degenerate ferns, clubmosses, and horsetails, found in Britain to-day, are the descendants of the luxuriant vegetation of long ago!

Yet, strange as it may appear, botanists are able to prove this is really the case.

We read of how fossil bones and shells have been found embedded in rocks, and we have no hesitation in believing that they are the remains of animals that lived ages ago. But plants are composed of a more perish-

able substance, and it is hard to believe it possible that we can expect to find fossil plants. Nor do we, as a matter of fact, find the actual substance of which the plants were composed preserved for us, but we discover that these ancient plants have left traces of their existence in the rocks, and the botanist skilled in deciphering such traces can read for us their story in much the same way as the historian can picture for us the past of a nation from a study of historical relics.

What are these traces? When the sinking of the land, to which we have already referred, took place, many leaves, twigs, branches, stems, and seeds must have been embedded in the mud or sand. By the time this mud or sand had solidified, forming a slaty shale or a sandstone, the actual substance of the plant fragments would have completely disappeared, but impressions of their outward forms would be left on the newly formed rocks. Some of the hollow impressions would be filled up again by later deposits of mud or sand, and then we should have what is called a "cast" of the original plant fragment; or, as sometimes happened, the stem—or, rather, part of the stem—of a plant may have been buried in a material containing some mineral in solution. As the substance of the plant decayed it was replaced, particle by particle, by the mineral matter, which subsequently hardened, so that an almost perfect model of the original stem fragment, sometimes including both internal and external features, was formed. But these petrifactions, as they are called, are not so common as

casts and impressions. All three are termed fossil plants.

From a study of these fossils the botanist is able to reconstruct in imagination the plants which grew during the age when ferns and their allies predominated. He sees also resemblances in structure between those old-time plants and certain forms which exist to-day. These points of resemblance—very marked in some cases—lead him to the conclusion that our present-day British ferns, clubmosses, and horsetails must be the descendants of the ancient plants we have mentioned in this chapter. Knowing, too, the conditions which are necessary for the luxuriant growth of such plants, he is able to picture for us what the earth was like in a very remote past.

CHAPTER II

FERNS : HABITATS, LIFE-STORY, AND MORPHOLOGY

In the last chapter we learned that the conditions most favourable for the luxuriant growth of ferns were those of heat, moisture, and shade.

For this reason our native ferns are to be found in greatest abundance in woodlands, where also they attain their greatest height. Here in summer their delicate fronds are shaded from the direct rays of the sun by the foliage of the trees, while in winter their vital parts are protected from the frosts by a thick covering of fallen leaves. The air, too, around woods and forests contains

a more copious supply of moisture than the atmosphere which surrounds more open situations. This is due to the presence of the trees, which give out through their leaves in the form of vapour all the superfluous water which they have drawn from the soil.

Similar conditions prevail in many of our country lanes, especially when shaded by trees and bordered by ditches, and in such places we may expect to find ferns of the same species as grow in woods. When these lanes or country roads are more exposed to the sunlight, and where there is a less plentiful supply of moisture, the woodland ferns will become dwarfed, and in some instances may completely die out.

Other ferns, again, seem to prefer the bogs and marshes or swamps, where they obtain an abundant supply of water, but suffer from the absence of shade. The foliage of ferns which grow in such situations is frequently found in a scorched condition, and generally dies down on the first approach of winter.

It seems very strange, when we recall the past history of ferns, to learn that the crevices of exposed rocks and walls are the chosen homes of many of our ferns. There they have often to endure scorching heat and long periods of drought. To enable them to do so they have developed a leaf texture much tougher than that of the fronds of the shade-loving ferns, and they have also reduced their leaf surface considerably. In fact, as a general rule, such ferns are small and insignificant.

Group of Male Ferns

PLATE 3

Other hardy ferns prefer the open moors, the hills, and the mountain slopes. Though smaller and less luxuriant than the woodland types, they are generally more robust. It is interesting to note the difference between the bracken of the wood and its more lusty brother which frequents the moors and the mountains. While the former is a taller plant, with leaves of a more tender green, the latter is hardier and has leaves of a tougher texture.

The most delicate of our native ferns, on the other hand, are only to be found mingling with the mosses on the dripping sides of waterfalls and on rocks kept continually moist by the streams in deeply shaded glens.

Let us now try to discover how we may always recognise ferns when we meet with them on our rambles. Most people who are not botanists will at once declare that here there can be no difficulty, as ferns are all so much alike, and that all may be readily known as ferns by their general similarity of appearance due to the finely cut leaves, or fronds. But there are certain plants of the fern order which do not possess these finely cut leaves, and there are others, particularly some belonging to the carrot and parsley family, the leaves of which are often mistaken for ferns by the young inexperienced fern-lover.

If we wish to make certain that the plant we are examining is a fern, we must turn over one of the fully grown leaves and carefully examine the back of it. What are these brownish or blackish circular

patches or lines? They are clusters of fruit-cases or capsules. Each cluster, called a "sorus" (plural, "sori"), has, in its early stages at least, a covering termed an "indusium," which is an outgrowth from the under-

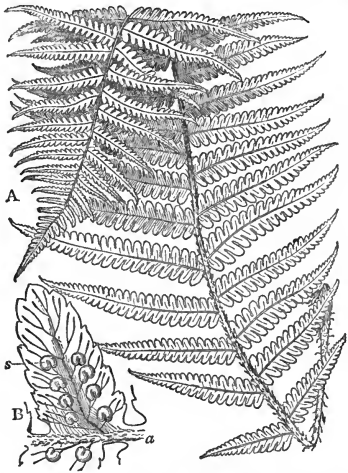


FIG. 1.—FERN FROND. (AFTER LUERSSEN.)
From "An Introduction to Structural Botany," by D. H. Scott.

A, Leaf of male fern (much reduced); *B*, part of a fertile pinna seen from below; *a*, rachis; *s*, sorus (magnified).

surface of the frond. It may be well to note in passing that in some ferns this indusium is never present. The shape or form of the indusium, linear, circular, or kidney-shaped, is of great assistance to us when we are identifying ferns—that is, finding out their names.

If examined under a good magnifying glass, these capsules (sporangia) are, in the majority of cases, seen to be raised on little stalks. Each capsule is filled with a powdery substance, which is set free by the bursting of an elastic ring by which the capsule is surrounded. This powdery substance consists of spores, popularly called fern seeds. They are not, however, true seeds,

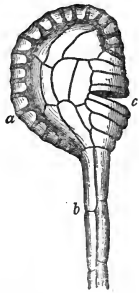


FIG. 2.—SPORE CAPSULE, OR SPORANGIUM. MAGNIFIED 100 DIAMETERS.

From "An Introduction to Structural Botany," by D. H. Scott.

a, Elastic ring ; *b*, stalk ; *c*, ring splitting to set free the spores.

all of which contain within the seedcoat, or outer covering, a baby plant with parts which can be clearly marked off as the beginnings of the root and stem of the future plant. Now, a spore has no such parts, but is of the same structure throughout, and contains nothing to suggest that it will ultimately give rise to a new fern-plant. The appearance, then, of sori on the

back or edges of the frond may be safely taken as proof that the plant under examination is a fern.

Many of the plants of the Coal Age referred to in Chapter I., though possessing fernlike leaves, bore seeds and not spores, and for that reason are no longer regarded as having been true ferns.

If we wish, however, to know the life-story of ferns, as well as their names, we must try the experiment of raising new fern-plants from spores. The process is a very simple and inexpensive one. Procure a packet of fern-spores from the florist, in the first instance, as the beginner is often disappointed, because the spores which he has collected himself fail to germinate. The reason for the failure is that either the spores were not ripe, when gathered, or, as frequently happens, spore cases only from which the spores have altogether disappeared have been sown in error. Next prepare a mixture of sand, leafmould, peat, and finely powdered soil for top dressing. Fill a pot with the mixture, paying particular attention to the drainage, and pour over the potted soil a plentiful supply of boiling water. This has the effect of killing any forms of life in the soil which might prove harmful to the germinating spores. When the soil has cooled, scatter the spores lightly over the surface, cover the top of the pot with a sheet of glass, and finally place it in a saucer of water. Keep the saucer plentifully supplied with water and do not disturb the spores by watering from above.

In a few months, in some cases weeks, a green

covering of sprouting spores will appear on the surface of the soil. Each spore that germinates produces a green, more or less heart-shaped scale, no bigger than the nail of the little finger. This little piece of plant

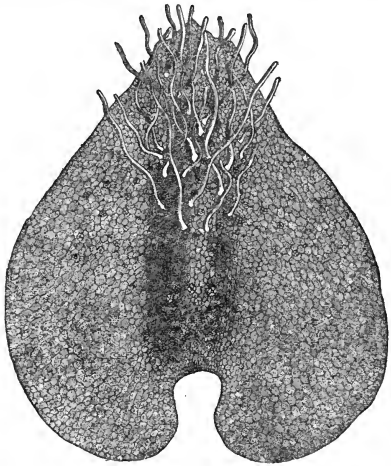


FIG. 3.—FULL-GROWN PROTHALLIUM SEEN FROM BELOW, SHOWING ARCHEGONIA NEAR THE NOTCH, ANTHERIDIA AND ROOT-HAIRS TOWARDS THE TOP. MAGNIFIED ABOUT 25 DIAMETERS. (AFTER LUERSSEN.)

From "An Introduction to Structural Botany," by D. H. Scott.

substance is called the fern prothallium. At this point we notice another distinction between a seed and a spore. A seed produces, without any intermediate stage, a plant like to that from which it has come, while

a spore grows, in the case of ferns, into a little leaflike body (it takes other forms in other plants), which has no resemblance whatever to the adult fern which produced the spore. This prothallium, as we shall now call it, sends roots, or to be strictly accurate, roothairs, into the soil, and takes in food from it and from the atmosphere in much the same way as the ordinary forms of plants procure nourishment from the same sources by means of roots and leaves. On the underside of the prothallium soon appear little cavities which can only be made out with the help of a microscope. The larger of the small cavities which have been compared to flasks, the necks of which project from the surface, while the bottoms are sunk into the substance of the prothallium, are the female organs and correspond to the ovaries of the higher plants. These archegonia, as botanists call them, lie generally near the notch on the prothallium, and each one contains one egg-cell which may afterwards grow into a new fern-plant. The smaller cavities, termed "antheridia," which are the male organs, contain little hairlike bodies (spermatozoids or sperms) which work their way out of their chambers, swim to the larger cavities, enter them, and unite with the egg-cells which the latter contain. The egg-cell thus fertilised gives rise to the young fern. Only one egg-cell in each prothallium appears to be fertilised.

How similar is this process to the fertilisation of the ovules in the ovary of the higher plants by the pollen

from the anthers! But we should do well to note that while the higher plants have often to depend on the wind, insects, or other agency for the transference of their pollen, water only is required in the case of ferns to ensure fertilisation of the egg-cells by the sperms.

For a long time the process of fertilisation in ferns was a great mystery, and it has been suggested that the want of exact knowledge of how new ferns were produced may have been the basis for the old-time and long-current superstition that the fortunate, or unfortunate, individual who carried fern seed—that is, fern-spores—in his pocket became invisible.

The first frond which develops from the fertilised egg-cell is a very simple one, which gives no indication of what the fully-grown fern will be like, but the later ones become more and more like the adult form which produced the spores. After two or three fronds have appeared, the prothallium withers away, and at last disappears. There is no longer any need for it, as the young fern-plant can now manufacture food and procure water for itself. In course of time this fern, whose life-history we are tracing, will bear spores similar to that from which it has indirectly sprung.

The various stages in the life-history of a fern may be briefly set down as follows: (1) The spore; (2) the prothallium; (3) the appearance of male and female organs; (4) fertilisation of the egg-cell; (5) the new fern; and (6) the production of spores.

If we regard the prothallium as the parent and the

fern-plant as the offspring, it will help us to understand what botanists mean when they say that ferns exhibit in their lives the phenomenon known as "alternation of generations." The prothallium they call the sexual generation, because it bears the male and female organs of the plant, and what we call the fern-plant botanists look upon merely as the spore-bearing generation in the life of a fern. Now, if we think of the prothallium giving birth to the spore-bearing generation, and of the spore-bearing generation producing new prothallia, which in turn give rise to a later spore-bearing generation, we see what is meant by saying the generations alternate with each other.

Having now learned something of the life-history of ferns, we must study for a little the fully-grown or adult fern. All ferns in the adult state possess roots, stems, and leaves. The roots are always fibrous (threadlike), and must be carefully distinguished from the stems which creep under, and sometimes above, the surface of the soil. These creeping stems, some of which attain to a considerable degree of thickness, are called "rootstocks," or "rhizomes." From the rhizomes the true roots grow downwards and the leaves upward. The leaves are sometimes arranged alternately on opposite sides of the rhizome, but at other times they are grouped in tufts or circles round its growing tip. Fronds possessing the former arrangement with regard to leaves may be said to have the power of locomotion and may be truly called "walking

ROYAL FERN
(*Osmunda regalis*).

ferns." Their prostrate stems continue year by year to grow onward and to branch freely, and thus the fronds of one season appear more or less distantly removed from the positions occupied by those of previous seasons. Ferns possessing rhizomes, or underground stems, with tufted leaves, have frequently their growing ends slightly elevated above the soil. This is the nearest approach in British ferns to the perfectly upright stems so characteristic of the tree-ferns of New Zealand and other places. The rhizomes which creep above the surface of the soil, and such as have their growing tips lifted out of it, are frequently clothed with a dense covering of golden or brownish scales, which are often continued up the leafstalk. These scales act as a protective covering against heavy rains and severe frosts.

The fern-leaf, or frond, consists of two parts—the leafy part and the stalk. The stalk is continued right up to the tip of the frond of which it forms the midrib. The leafless part is termed the "stipes," and its continuation, the "rachis." The mistake, which many fall into, of regarding the leafstalk as a stem, more especially when examining ferns with branching leafstalks, must be carefully avoided. The beautiful little oak-fern of our woods is a case in point. From an underground rootstock appear leafstalks which, at a distance of 1 or 2 inches from the ground, send off branches, one to the right and one to the left. At a first glance we are greatly tempted to call the lower part of the

leafstalk, the stem, and its branches, the leafstalks of separate leaves, but because we know the real stem is underground we can understand why the frond of the oak-fern is looked upon simply as a leaf cut into three main divisions, or, in other words, as a trifoliate leaf.

When the fern-leaf first emerges from the soil it is coiled or rolled up in such a way as to resemble a shepherd's crook or a bishop's crosier. Of course we cannot fail to notice how effective this arrangement is as a protection to the delicate tissues of the fronds when they are forcing their way upwards through the ground. When once clear of the soil the leaf begins slowly to uncoil and to straighten out. Only two British ferns—the Adder's Tongue Fern and the Moonwort Fern—do not have their young fronds rolled up in this fashion. In the case of both of these ferns, the fronds are, before being expanded, folded at right angles to the midrib, and so folded they push their way through the soil.

In describing ferns, certain terms referring chiefly to the leaf divisions are employed, with the commoner of which it is very necessary that we should be acquainted. Most ferns have very much divided leaves, and very few have uncut or entire leaves. If a fern-leaf be cut almost to the midrib, we call it a "pinnatifid" leaf, and when this cutting extends right down to the midrib, so as to divide the frond into separate segments or leaflets, each leaflet is called a "pinna," and the whole frond is described as "pinnate." If each pinna be again cut

pinnately, the frond is termed a "bipinnate" one, and if the secondary pinnæ or pinnules, as they are called, be divided in a similar manner, the term "tripinnate" is applied to the whole frond. Very few British ferns are ever more intricately divided than those which are tripinnately cut.

The following is a short summary of the contents of this chapter:

1. The favourite habitats of British ferns are woodlands and shady glens, bogs and marshes, moors and mountains, country lanes, and the crevices of walls and rocks.

2. Ferns may be recognised as such by the clusters of spore cases borne on the backs or edges of their usually much-divided leaves.

3. Fern-spores produce prothallia, from which spring new fern-plants. Thus there are two generations in the life of a fern—the prothallium, or sexual generation, and the spore-bearing, or asexual generation, which alternate with each other.

4. Ferns possess roots, stems, and leaves, but the stems of British ferns are never perfectly upright.

5. Fern-leaves, or fronds, are described as pinnate, bipinnate, tripinnate, pinnatifid, or entire. These terms have reference to the leaf divisions.

CHAPTER III

FERNS OF THE WAYSIDE AND SEASIDE ROCKS AND WALLS

In this and the three following chapters we shall visit the ferns in their homes. When there, we shall note how the leaves or fronds are cut or divided, and how the sori are arranged, whether on the backs or edges of the frond, whether covered by indusia or not, and whether borne on special fronds or on the ordinary leafy ones. We must do so if we wish to know the names of ferns, because the leaf divisions and the arrangement of the sori are the chief guides on which we rely when we set out to identify ferns. As most ferns have their sori arranged on the backs and not at the edges of the fronds, we shall assume in our descriptions that the sori are dorsal (placed on the back) unless otherwise stated. Similarly, we shall assume that the sori are set on the ordinary leafy fronds, unless attention is called to the contrary. To make our study of ferns more interesting we shall recall many of the old beliefs that our ancestors held regarding these beautiful plants. We shall call first on those ferns which grow in the crannies of walls and rocks by the wayside and by the seaside. Of course, there are rocks and walls to be found in woods and in mountainous districts, but we shall postpone making the acquaintance of the ferns which

grow there till we have exhausted all the forms to be found on wayside and seaside rocks and walls.

Here is an old wall running along the roadside, and forming the boundary of a field. The prosaic person may tell us it is in a ruinous condition, and sadly in need of the plasterer's care ; but what a joy it is to the fern-lover ! Peeping out from a chink between two of the rough, unhewn blocks of stone is a little dark-green fern. Are we sure it is a fern ? Let us put our knowledge to the test. On the back of the leaf, which is only 2 or 3 inches long, we notice the sori, or clusters of spore cases. "It is a fern !" we at once joyfully exclaim.

We shall now examine it more particularly. The leaves, which grow in tufts, are borne on very wiry leaf-stalks, which are black towards the bottom. The lower leaflets (pinnæ) are stalked, and are themselves divided into smaller leaflets (pinnules), but not in a very regular manner ; therefore we say the frond is irregularly twice pinnate. The upper pinnæ, however, are quite entire. Each little division of the leaflet is roughly wedge-shaped, and rounded and toothed at the tip ; but when we are told that this is a very variable little fern, we are not surprised when we meet with fronds that do not quite answer to this description. The creeping stem, or rootstock, as it is generally called, is short, and the roots are long, to enable them to reach the food-supplies in the scanty soil which has somehow managed to lodge itself between the stones.

This fern is the Wall-rue, so-called because its favourite home is old walls and because its leaves resemble those of the garden rue. Its scientific name is *Asplenium Rutamuraria*, the second part of which simply means Wall-rue. All plants have two names; the first is the name of the genus, a group of plants possessing many characters in common, while the second is the name of the species, a subdivision of the genus. Thus plants have generic and specific names, which may be compared with the family and Christian names which we have found it necessary to adopt, so that we may be readily distinguished not only from our neighbours, but also from the members of our own family.

The genus *Asplenium* (Greek, *splene*, the spleen), to which the Wall-rue and six other ferns to be described in this chapter belong, is so named because long ago it was believed that a preparation made from the leaves of some of its members was an excellent remedy for diseases of the spleen. For this reason also they are all popularly termed Spleenworts. Now, if we examine carefully the sori on the back of the frond we shall discover the distinguishing mark of the Spleenworts. We must not choose a frond too young or one too old. On the first the sori may not yet have appeared, and on the second they will have probably grown so close together that we cannot separate out one sorus from the mass.

Here is one on which the spores are not yet ripe. The sori are now seen to be arranged in lines and

covered by indusia, which open along their length on the side facing the midrib. All the Spleenworts show these linear sori, covered in almost every instance by indusia, so that it is not very difficult to tell when a fern belongs to the genus *Asplenium*.

Before we leave the Wall-rue let us recall what we learned in the last chapter about ferns that grew on walls and rocks. They were not, as a rule, tall plants, and their leaves were generally small and of a hard texture. Well, the Wall-rue is a good example of such a fern. Possessing such small, leathery leaves, it loses little of its scanty supplies of water through transpiration. Thus we see that the leaves have become small, so that the little Wall-rue may husband every drop of water that may reach its roots.

Farther along, on the same wall, we are almost certain to meet with another diminutive fern, the Common or Maidenhair Spleenwort. Like the Wall-rue, it has taken advantage of one of the crevices of the wall, into the utmost recesses of which it has pushed its fibrous roots. The contrast between the delicate green fronds and the drab-coloured stones over which they are spread is most pleasing to the eye. These fronds are once pinnate, with pinnæ varying in number from seven to twenty pairs, but it is only in exceptionally well-developed specimens that twenty pairs of pinnæ are to be found. The tip of the frond bears an odd pinna. The pinnæ are all so shortly stalked that they appear stalkless. They are dark green in colour, oval in shape,

and on an average less than ½ inch long. The edges of the pinnæ are often bluntly toothed or crenate. Thus we see that, like the Wall-rue, this fern exhibits the reduced leaflets so necessary for a plant whose water-supply is often very insufficient. The leafstalks, which are very numerous and highly polished, are of a deep chestnut-brown above with a blacker tint below. They do not decay when the pinnæ die off, and consequently an old fern of this species has often a very untidy appearance. These leafless and dark-coloured stalks suggested to our fanciful ancestors the name "maiden-hair." They seemed to see in them some resemblance to a maiden's tresses.

The rootstock, which appears rather stout for so fragile-looking a fern, creeps a little and bears a few blackish awl-shaped scales. The sori, on the back of the leafy fronds, are similar to those of the Wall-rue, proving this fern is an Asplenium. Its full botanical name is *Asplenium Trichomanes*. The exact derivation of *Trichomanes* is unknown. One suggestion is that the word is formed from two Greek words signifying "hair" and "excess." According to this etymology, the reference in the name is to the hairlike leaf-stalks.

While the last two ferns are fairly well distributed throughout Britain, the next two, to be more shortly described, are rare, and we may never have the opportunity of actually collecting them. But our wall is a very prolific one, aud we may in imagination

2 3 *T. Ernest Waltham.*

1. Beech (*Polypodium phegopteris*).
2. Oak (*P. Dryopteris*).
3. Common Polypody (*P. vulgare*).

see them growing in company with the Wall-rue and the Maidenhair Spleenwort.

The first is the Alternate-leaved Spleenwort. At a first glance this fern might be considered an exceptional form of the Wall-rue, but botanists now agree that it is a distinct species.

The frond is simply pinnate, with the pinnæ arranged in an alternate manner on the leafstalk. Each pinna is wedge-shaped, with the broad end cut into toothed lobes, or segments, which are more prominent on the lower than on the upper pinnæ. The erect fronds which grow in tufts are almost evergreen, and are rather thick in texture. The average height of the frond, including the leafstalk, is about 4 or 5 inches.

Asplenium germanicum is the botanical name of this fern. Some writers attempt to account for the specific name on the ground that it is a favourite fern in Germany, while others are of the opinion that the name merely points to the relationship between this fern and certain other members of the same genus. If the latter interpretation is the correct one, it would appear that the word is akin to the English word "german," in such compounds as "cousins-german," etc.

The second of the rare rock or wall Spleenworts is the Forked Spleenwort, a very small evergreen fern with fronds of a leathery texture. The tiny erect frond, the leafy part of which is seldom more than 2 inches long, is cut into narrow alternate segments, with well-marked teeth at the tip. Though one of

the least of British ferns in height, it is remarkable for the very large number of leafstalks springing from the tufted rootstock. The striking resemblance of this fern to the Buckthorn Plantain found on seaside rocks has often been commented on. It is named *Asplenium septentrionale.* The specific name, which means "northern," refers to the fact that it is more frequent in the north than in the south.

One other fern, one of the commonest of British ferns, we are sure to have growing on our old wall. This fern is the Common Polypody, which is so very distinct from all other native species that we have no difficulty in at once recognising it. Its fronds, which vary in length from 6 to 16 inches, are at first upright, but, as they grow older, they assume a hanging position. They are cut in a pinnatifid manner, the segments growing smaller and closer as they reach the tips of the fronds. Each segment is generally rounded at its extremity, and may or may not be slightly toothed.

Examining the back of the frond, we find the spore cases of a golden-brown colour disposed in circular clusters along both sides of the midribs of the segments. The sori never have indusia, or coverings. This absence of indusia, taken along with the circular or globular sori, is the distinguishing mark of all the Polypodies.

The rootstock is stout and creeping, and in its early stages is covered with scales. From this creeping stem leaves and roots are given off, but the leaves do not grow in tufts at its extremity, but spring alternately

PLATE 6

Male Fern in Early Stage of Growth

from its sides. The leafstalks, which are almost equal in length to the leafy part of the frond, are jointed to the rootstock, just as the leaves of trees are attached to the twigs, and when they decay they leave behind a tiny scar. This is a very exceptional feature in British ferns. Since it is so common a fern, we are not surprised to learn that our ancestors turned it to account in the preparation of homely medicines. Concoctions prepared from the Common Polypody were once highly recommended for treating violent cases of whooping-cough. It was also much sought after in earlier times by glass manufacturers, who had discovered that it contained large supplies of carbonate of potash.

Though frequently found on walls, the Common Polypody is by no means restricted to such situations. We find it often on the banks by the hedgerows, on mossy tree-trunks, and even on the thatched roofs of cottages.

The botanical name of this fern is *Polypodium vulgare*. *Polypodium* means "many-footed," a reference, most probably, to the branching rootstock, while *vulgare* is a Latin word meaning "common."

Now, if our old wall happens to be in a limestone district, we may often find in company with these ferns already described a unique fern, the Scale, or Ceterach, Fern. Its fronds springing from a short stout rootstock are deeply pinnatifid, each oval segment being of a deep green colour. These segments are set alternately on the rachis, and are separated from each other

by a rounded notch. Unlike all other British ferns, the Ceterach Fern has the back of its fronds so completely covered with reddish-brown scales that we have a difficulty in making out the sori. If, however, the scales, which, it should be noted, are silvery white when the fronds are first unrolled, be carefully removed, its linear sori will be apparent. Indusia do not seem to have been developed, the reason being that their work of protecting the sori is performed by the covering scales. But it is most probable that the chief function of the scales is to act as a check on the transpiration of water through the leaves, so that in addition to its small leathery leaf segments, this fern has a further means of defence against drought.

If we were to visit this fern after a long spell of dry weather, we should be inclined to say, judging from its shrivelled up appearance, that it was in a dead or dying condition. The segments of the fronds have folded themselves together facing the midrib of the frond, while the whole frond appears to be rolling itself up from the tip downwards. But after a refreshing shower of rain the fronds will again assume their fully-expanded upright form.

Of all ferns of the genus *Asplenium* the Scale or Ceterach was regarded as the most efficacious in curing disorders of the spleen. In fact, according to the legend, Cretan sheep, which greedily devoured the root-stock, not only recovered from diseases of the spleen, but in course of time lost that organ altogether.

The Lanceolate Spleenwort

The botanical name of the Scale Fern is *Asplenium Ceterach*. The latter word is supposed to be a corruption of the Arabic, "Cheterak," applied to this plant by Eastern physicians because of its alleged effectiveness in curing diseases of the spleen. This explanation, however, is not to be relied on.

Leaving our old wall, we now reach a part of the road where the rock formation has been laid bare. The road-maker has cut his way through a rising part of the ground and left exposed the underlying rocks. The drainage from the ground on the top dripping over the exposed section of rock keeps it in a wet or moist condition.

On this exposed rock we find the Lanceolate Spleenwort. As its name implies, this fern is roughly lanceolate in outline, lanceolate being a term applied to a leaf, longer than broad, broadest about the middle, and tapering to both ends. The fronds are rather delicate in texture. Having at hand an ample supply of water this fern does not require leathery fronds to act as a check on transpiration. Each frond is twice pinnate, the pinnæ being cut into ovate (egg-shaped) or obovate (inversely egg-shaped) segments, all sharply toothed. The leafstalks are glossy and of a reddish-brown colour, while the short rootstock is covered with awl-shaped scales. On the back of the pinnules are the sori which must be examined in the young and immature state, as when older they swell out and become more or less circular.

It may be as well to state here that this fern is confined to England and Ireland, and does not extend into Scotland. It is known, botanically, as *Asplenium lanceolatum*. The reason for its specific name has already been given.

On a drier part of the rock, grows the Black Maidenhair Spleenwort Fern which, as may be judged from its tougher leaves, appears to be better adapted to dry situations than the Lanceolate Spleenwort. Though frequently found on the sides of waterfalls and in the hedgerows, its favourite habitats are walls and rocks. It is a very common fern throughout Britain. Its fronds, varying from 6 to 12 inches in length, are twice pinnate and in large specimens frequently thrice pinnate. In outline it is roughly triangular in shape, tapering away to a long point. Each separate pinna also shows the triangular form with base towards the rachis, while each pinnule is wedge-shaped and cut into toothed lobes. The rootstock is thick and covered with scales. Like so many of the Spleenworts, this fern has leafstalks of a brownish black colour towards the base. The sori, when old, run together, and are so numerous as almost to cover each little pinnule. At first they are covered by whitish-brown indusia, which latterly disappear.

This fern is named *Asplenium Adiantum-nigrum*. *Adiantum* is formed from a Greek word meaning "unwetted," and is applied to this fern, because its fronds, like those of the true Maidenhair Fern, whose

Fronds of Bracken unfolding

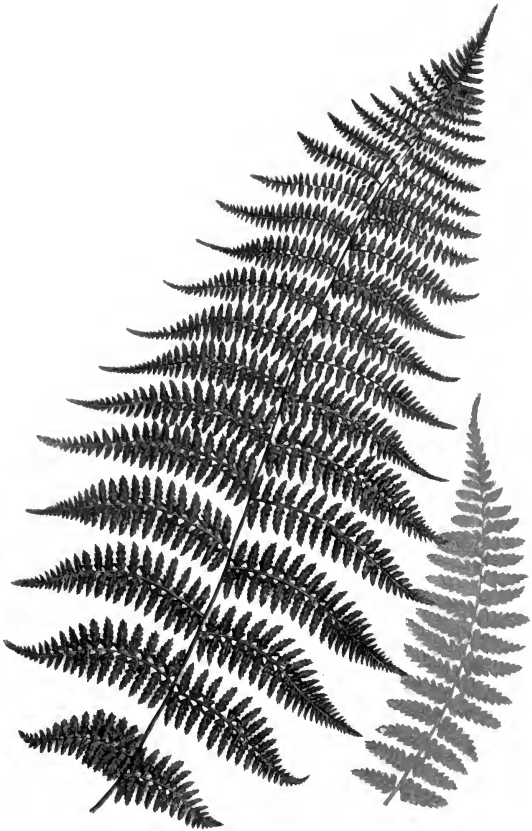
generic name is *Adiantum*, have the peculiarity of remaining dry when exposed to the rain. *Nigrum* means "black," and its application to this fern, with its blackish leafstalks, is readily apparent.

Let us now quit the highway, and examine the rocky caves by the seashore. Here we find the Sea Spleenwort, which seldom grows far from the neighbourhood of the sea. In the deepest recesses of the cave generally, though often in more exposed parts, we find it either growing erect on the ledges of rock, or hanging its deep green glossy fronds from the roof of the cave. The thick leathery fronds, which are simply pinnate, vary from 3 inches to 1 foot in length. Each pinna, which is about 1 inch long, is roughly oblong, rounded or acute at the tip, wedge-shaped at the base, lobed or toothed, and marked by an ear-shaped enlargement on the side nearest the tip of the frond. Between each of the lower pinnæ the rachis is winged, but towards the tip of the frond the upper pinnæ run together. The leafstalks are strong, reddish-brown below, and glossy. Purplish-brown scales clothe the thick rootstocks, which are extremely difficult to dislodge from the crevices in which they grow.

The linear rust-coloured sori are large and easily made out, and the indusia are tougher than usual. The popular name Sea Spleenwort is simply a translation of *Asplenium marinum*, the name by which this fern is known to botanists.

Another fern, though a very rare one, we may chance

to find in our sea-cave is the True Maidenhair Fern, which, however, is confined mostly to the South of England and the West of Ireland. It has fronds from 4 to 12 inches long, and two or three times pinnately cut. The pinnules are for the most part fan-shaped in outline. The leafstalks, which are alternately branched, are very slender, black, shining, and quite bare of scales. To the ultimate divisions of the leafstalks, which are almost hairlike, the fan-shaped pinnules are attached. The creeping rootstock is also very slender but scaly. The short oblong sori are borne on the edges of the upper pinnules, which curve over and so serve as indusia. This native Maidenhair Fern can be easily recognised, when found, from its similarity to the many foreign species now cultivated in Britain. The ailments which this fern was formerly believed to cure were many and varied. It was esteemed a valuable specific for troublesome coughs, jaundice, swollen joints, and diseases of the lungs, while a preparation of which it formed one of the chief ingredients was formerly much recommended as a hair-restorer. The scientific name of this fern is *Adiantum Capillus Veneris.* The derivation of *Adiantum* has already been given. *Capillus Veneris*, meaning, "the hair of Venus," obviously refers to the delicate leafstalks and branches.



LADY FERN (*Asplenium filix-fœmina*).

CHAPTER IV

FERNS OF THE BOGS AND MARSHES

On our second visit to the ferns in their homes, we must see that we are well shod with strong waterproof boots, for on this occasion we shall call on those ferns whose homes are bogs, marshes, and damp meadow lands.

In one of the marshes by the river's bank we expect to make the acquaintance of the Royal Fern. A truly appropriate name does this magnificent fern bear. Luxuriant specimens have been measured and found to reach a height of 12 feet, but we may consider ourselves fortunate if we meet with one even a quarter of this height. The yellowish-green fronds are twice pinnate, the pinnules being oblong, blunt at the tip, with an ear-shaped enlargement at the base on the side nearest the rootstock. So completely do the sori cover the upper pinnules of some of the fronds that no green part can be seen. The lower pinnules of the same fronds, on the other hand, are quite free of sori. Other fronds are entirely barren—that is, they bear no sori whatever. This dense clustering of the sori on the upper parts of some of the fronds gives the whole fern a remarkable appearance, and is a sufficient mark by which we may identify the Royal Fern at a glance. We should also note that the sori are naked, possessing

no indusia, and that the spore cases which split into two valves to release the spores are without the elastic ring referred to in the second chapter.

The leafstalks are very distinct, and nearly equal in length to the leafy part of the frond. At first they are reddish-brown, but, as they grow older, this colouring matter disappears. The rootstock is large, very thick, frequently trun-klike, and covered by a dense coating of dark-coloured fibres.

According to the old herbalists, the Royal Fern possessed very wonderful healing powers. Preparations made from it were prescribed, not only for external complaints, but also for more deeply-seated internal troubles. In fact, it was believed to possess in itself all the curative virtues of the whole of the fern order of plants.

Popularly, this fern is best known as the Flowering Fern, but we know better than to apply such a term to a fern. Those who first called it the Flowering Fern must have been misled by the dense masses of sori at the top of the fronds, which were mistaken for small flowers. Botanically, this fern is *Osmunda regalis.* Many different explanations have been given of the word *Osmunda.* Some believe that it is derived from Osmunder, one of the names of the old god, Thor, while others maintain that the derivation is *os*, "a house," and *mund*, "peace." A more fanciful explanation is that the fern is called *Osmunda* after Osmund, a ferryman, who saved his beautiful daughter from

falling into the hands of marauding Danes by hiding her among the tall fronds of the Royal Fern. The large, whitish core of the rootstock is referred to by one old writer as "The Heart of Osmund."

Which is the correct derivation of *Osmunda*, and why this fern has been so called, it is difficult to say definitely. *Regalis* is, of course, Latin for "royal" or "kingly," an obvious reference to the majestic appearance of the fern.

Let us now leave the river bank and explore the peaty bogs. There we expect to find the Marsh Fern which, it should be noted, is much rarer in Scotland and Ireland than in the South of England.

It is one of the Buckler Ferns, and as there are seven ferns of this family, we had better give some attention to the marks by which these ferns may always be recognized. Turning to the sori, we notice that they are circular and covered with a kidney-shaped (roughly circular, but notched) indusium, which is attached to the leaf segments near to the notch. We must be very careful to examine the sori of these ferns, before they are mature, as in some cases the indusium disappears entirely, and we have great difficulty in recognising the plant under examination as belonging to this class of ferns. The delicate green fronds of the Marsh Buckler Fern are of two kinds—barren and fertile. The latter are so-called, because the frond segments are spore-bearing, while the former are quite destitute of spores. Both fronds are lanceolate in outline and

once pinnate. Each pinna, which has untoothed but slightly rounded edges, is cut almost to the secondary midribs in a pinnatifid manner. The fronds, including the leafstalks which are rather slender, bare of scales, and straw-coloured, vary in height from 1 to 3 feet. The long, black rootstock is a true rhizome, creeping extensively and sending up fronds at intervals and not in tufts.

When we look at the almost transparent leafy parts of the fronds, we can understand why this fern is quite unfitted to endure the winter frosts. By the end of September, sometimes before it, the fronds will have completely disappeared.

The botanical name of this fern is *Nephrodium Thelypteris*. The generic name is derived from a Greek word meaning "kidney," and the specific name, also from the Greek, means "ladyfern," which was thought to be a suitable name for this fern because of its delicate, graceful fronds.

Another and a much rarer *Nephrodium* to be found in bogs is the Crested Buckler Fern, which is confined mainly to England. The fronds of this fern are oblong in outline and once pinnate. The shortly-stalked pinnæ are also oblong in shape, with lobed and toothed segments attached to the midribs of the pinnæ by dilated bases. We must note the very erect posture of these fronds, which range from 1 to 3 feet in height, with leafstalks measuring about one-third of the entire frond. The rootstock, which is covered with long,

pointed, pale brown scales, creeps and branches, sending up tufts of fronds from each branch.

Like its relative, the Marsh Buckler Fern, the Crested Buckler Fern dies down very early in autumn. It is known as *Nephrodium cristatum*, the latter term meaning "crested."

We shall now leave the bogs and turn to the damp pasture-land where dwells a very strange fern indeed—namely, the Adder's Tongue Fern. Unless we are particularly watchful, we may overlook it, though it may be quite plentiful in the meadow where we are searching for it. It is quite unlike in appearance any of the ferns we have already examined.

The frond consists of two parts, a leafy part and a spike. The leafy part which is very shortly stalked and about 6 inches in length is oblong in shape, entire, and barren, while the spike is distinctly stalked and has the large spore cases arranged in two rows along its edges. These spore cases, which are embedded in the substance of the spike, lack the elastic ring and split transversely, in order that the very small spores may be liberated. We must also note the exceptional arrangement of the veins in the blade or leafy part of the frond. Most ferns have branched or forked veins, but the Adder's Tongue Fern has netted veins with no distinct midrib. The rootstock is short, with fleshy, brittle, coarse roots, and it is very difficult to uproot this fern without damaging it. We have already noticed also the exceptional way in which the young

fronds of this fern are unfolded. Though the blade of the frond is rather tough, its duration is very brief. We must search for this fern during the months from May to August, or we shall be disappointed at not finding it, even though we have been directed to one of the stations where it flourishes.

This fern received its popular name because of the fancied resemblance of the fertile spike to the tongue of the adder, but the resemblance is more fancied than real. Our ancestors had many strange ideas about plants, one of which was that each plant bore a mark or signature to indicate that it might be made use of as a remedy for particular forms of disease. Having once imagined that the spike referred to was like an adder's tongue, they forthwith came to the conclusion that the plant was intended as an antidote to the poison of the adder. *Ophioglossum vulgatum,* the botanical name of this fern, simply means Common Adder's Tongue, *ophioglossum* being derived from the Greek words, *ophis* and *glossa*, meaning "snake" and "tongue," while *vulgatum* is Latin for "common."

A near relative of the Adder's Tongue Fern, and an equally strange plant, is the Moonwort Fern, but we must leave the damp pastures for much drier places if we would make its acquaintance. The grassy banks of the uplands are its favourite habitat, though it may be often found at sea-level, where it grows much taller. Like the Adder's Tongue Fern, it has the frond divided into two parts, a barren leafy blade and a spore-

bearing branch. The surface of this branch is covered with closely-arranged round spore capsules which split transversely, as the spore cases of the last-mentioned fern do. The leafy part of the frond which is from ½ to 2 inches long, is pinnately divided into semi-circular or crescent-shaped pinnæ, which are either entire or toothed. The rootstock, which is small and tuberous with fleshy roots, has the bud of the next year's frond concealed at its apex. Many magical powers were ascribed to this fern by the botanists of other days. Locks flew open when the Moonwort Fern was inserted into the keyhole, and one fairy tale is told of a certain Earl, whose horse lost its shoes through the nails falling out, as he rode over a moor carpeted with Moonwort Ferns.

Botanists know this fern as *Botrychium lunaria*. *Botrychium* comes from a Greek word meaning "a cluster," a reference to the closely-arranged sori on the fertile branches of the fronds. *Lunaria* is derived from the Latin word *luna*, "the moon," and was applied to this fern because of the shape of the pinnæ on the leafy part of the frond. No general description has been given of the genera *Osmunda*, *Ophioglossum*, and *Botrychium*, as each of them contains only one British species, fully described in this chapter.

CHAPTER V

FERNS OF THE WOODS

On our third visit to the haunts of ferns we shall make a woodland our destination.

Woodland ferns love the shade afforded by the leaves of the overhanging trees, as in most cases their delicate fronds are quite unable to stand exposure to the scorching rays of the summer sun.

This woodland of ours is intersected by a brawling stream, leaping from rock to rock, and throwing itself in glee over waterfalls great and little.

Let us first explore these parts of the wood where the soil is damp or moist. There we find the Beech Fern, *Polypodium Phegopteris.*

The naked circular sori on the back of the frond at once mark out this fern as a Polypody. The rootstock is a creeping one, and is covered at intervals with scales. From this rhizome the fronds are given off alternately. The leafstalk is almost equal in length to the leafy part of the frond, and is scaly at the base. The leafy part, about 6 inches in length, is delicate in texture and triangular in outline, pinnately cut at the bottom, and divided in a pinnatifid manner at the top. The lower pinnæ are also deeply cut. The under surface of the frond is soft to the touch, which is due to a slight

1. Adder's Tongue (*Ophioglossum vulgatum*).
2. Lesser Adder's Tongue (*O. lusitanicum*).
3. Moonwort (*Botrychium lunaria*).

covering of soft hairs. This fern, however, may be most easily recognised by the lowest pair of pinnæ pointing in an opposite direction from the others—that is, away from the tip of the frond.

The popular name of this fern is a translation of *Phegopteris*, though the fern has really no association whatever with the beech-tree, nor does it resemble one in the slightest degree.

Not far from the home of the Beech Fern, and in a similar soil, we meet with a fern which we at once recognise, from the kidney-shaped indusia of the sori, which in this fern are confined mainly to the upper half of the frond, as a *Nephrodium*, or Buckler Fern. We notice that the rootstock is more erect than is usual in British ferns, and that the fronds spring from the top in tufts. The strong, pale-coloured leafstalks and the leafy parts of the fronds are each about 1 foot in length, the former bearing a few scales. The fern frond proper is oblong, or oftener lanceolate, in outline, and is twice pinnate, the lower pinnæ measuring on an average about 3 inches in length, and being themselves cut into pinnules 1 inch long, strongly pinnatifid, and furnished with teeth of a spinous character. But it is extremely difficult to give an exact description of this fern, as it is a very variable one, the forms which it assumes often causing much perplexity even to the skilled botanist.

Its botanical name is *Nephrodium spinulosum. Spinulosum*, meaning " provided with little thorns or spines,"

refers to the pointed teeth of the ultimate divisions of the fronds.

Higher up on the bank of the stream, in a drier situation, we are sure to encounter the Male Fern, *Nephrodium Filix-mas*, one of the commonest ferns in Britain. It is a very easy fern to identify. When once we have recognized from the lead-coloured sori, which are rather large and very numerous, that this fern is a *Nephrodium*, we may easily identify it from the dense brownish-yellow scales which clothe the rather short leafstalks and sometimes the midribs of the fronds as well.

From the strong rootstock spring six or more tall, almost erect, fronds, which frequently reach a height of 3 feet. The fronds are generally twice pinnate, with the pinnules deeply and bluntly cut. These segments, again, are either toothed or entire.

Although this fern attains its greatest height and luxuriance in woodlands, it is by no means restricted to such situations. It is quite a common fern in the hedgerows or on the open moor. The Male Fern is now the only British fern utilised by the medical profession. From it is prepared a specific for the expulsion of worms from the human body. Our ancestors, however, had greater faith in its wonderful healing powers, as the list of ills it was believed to cure attests.

Filix-mas is made up of two Latin words—*filix*, "a fern," and *mas*, "a male."

The name Male Fern was applied to this fern,

because of its robust appearance and erect growth as contrasted with the graceful, drooping, and delicate fronds of the Lady Fern. We must beware of imagining that there is any relationship between the Male Fern and the Lady Fern further than that they both belong to the same order of plants—namely, Filices, or Ferns.

In a dry, shaded part of our wood grows the delicate little Oak Fern, *Polypodium Dryopteris*.

It is one of the most fragile of our native ferns, readily destroyed by the buffeting of the wind or by too great exposure to sunlight. The rhizomes of this fern are long and slender, and covered with yellowish scales. As this fern generally grows in company with many of its kind, the creeping rootstocks become interlaced, and form a dense matted tangle. The leafstalk is also long and slender, and splits into three branches, hence the Oak Fern is sometimes called the Three-branched Polypody. This branching of the leafstalk is an easy guide to the identification of the Oak Fern. The strange appearance of the unrolling fronds is always commented on in all books on ferns. At a certain stage of growth the triple fronds, before unrolling, resemble "three little balls on wires." The leafy frond, which is quite smooth and of a most beautiful tender green, consists of three segments. All the segments are similarly divided, being pinnate at the base, but only pinnatifid at the top. The pinnæ of each segment are again deeply pinnatifid. The round, globular sori, without indusia,

are to be found near the margins of the leaf segments of the trifoliate fronds.

The Oak Fern, which is seldom more than from 9 to 12 inches in height, dies down annually at the first approach of the frosts of autumn.

Dryopteris is formed by two Greek words meaning "oak" and "fern," though there is no apparent reason why the fern described above should be styled the Oak Fern.

Not far removed from this colony of Oak Ferns we come upon the best known and, perhaps, the most beautiful of all our woodland ferns, the tall Lady Fern, with its bright green delicate fronds bending gracefully outwards from the tufted rootstock. Though preferring situations where it can obtain abundant supplies of moisture and protection from direct sunlight, it appears to be able to adapt itself to what we might imagine to be less favourable habitats—namely, dry hillsides, hedgerows, and rocky places.

The botanical name of this fern is *Asplenium Filix-fœmina*. When we recall what we learned in a previous chapter about the linear indusium of the genus *Asplenium*, we may be a little surprised, on examining the very numerous sori of the Lady Fern, to find that some of the clusters appear to be covered with indusia resembling those of the Buckler Ferns. For this reason some botanists will not admit this fern to the genus *Asplenium*. We must be careful, then, to examine the sori of the Lady Fern before the spores are

scattered, for after this has taken place the indusia become bent or reflexed and there is much difficulty in making out their true shape. The Lady Fern possesses a stout, half-erect, rootstock covered with rusty scales. As in the case of the Male Fern, the tall fronds are arranged in tufts round the growing point of the rootstock.

The leafstalks are rather thick but easily broken, and very scaly towards the base. The fronds are bright green in colour and of so delicate a texture that they soon shrivel up when gathered. They are oblong or lanceolate in outline and twice pinnate. Both pinnæ and pinnules are stalkless, and set very close on the midrib and its divisions. The sori are very numerous but small, and, as already remarked, the indusia are frequently curved. Perhaps the easiest guides to the recognition of this fern at a glance are the tender green of its foliage, the graceful arching of the fronds, and the finely cut and closely arranged segments of the pinnæ and pinnules. Very many varieties of this fern have been enumerated, but it will be sufficient for the present to regard them all simply as Lady Ferns.

Filix-fœmina are two Latin words. *Filix* is "a fern," and *fœmina*, "a woman." The name Lady Fern, as has already been suggested, was bestowed on this fern because of its fragile and graceful appearance compared with that of the more robust Male Fern.

Before leaving the wood proper to explore the wet rocks and the dripping sides of the waterfalls, let us not

fail to mark the Common Prickly Shield Fern. It belongs to the genus *Aspidium*, which is often confused by the beginner with the genus *Nephrodium*. The latter genus had the indusia, as we have seen, kidney-shaped, while the Shield Ferns, the name given to all ferns belonging to the genus *Aspidium*, have circular but unnotched indusia, attached by short stalks from their centres to the under surface of the frond. This method of attachment is described as "peltate." Thus we say the distinguishing mark of the Shield Ferns is globular sori, covered by circular and peltate indusia. We may find the fern we are in search of at the border of the wood partially sheltered by the trees.

The rootstock from which the fronds spring in tufts is unusually stout, and the leafstalks and midribs are thickly clad with rusty scales. The fronds which are often from 2 to 3 feet in length are lanceolate in outline, dark green in colour, and shining or glossy on the upper surface. They are bipinnately divided, the pinnules nearest the principal midrib showing an ear-shaped enlargement on the side nearest the midrib of the pinnæ. These pinnules which are furnished with rather sharp, prickly teeth can hardly be said to be stalked, being rather what botanists call decurrent—that is, not attached by a stalk, but by their base, which is prolonged downwards. There are two varieties of this fern, but as so good a botanist as the late Sir J. D. Hooker hesitated to rank them as species, we may omit them from our list of woodland ferns.

Ferns with strange Indusia

The botanical name of the Common Prickly Shield Fern is *Aspidium aculeatum*. *Aspidium* is a word made from the Greek *aspis*, "a shield," a reference to the shape of the indusium, while *aculeatum* is a Latin word meaning "furnished with thorns or prickles." The specific name is, of course, due to the teeth with which the pinnules of this fern are provided.

Having exhausted all the ferns likely to be found in the wood proper, we must now turn our attention to the stream over which the arching trees hang their foliage, forming a screen through which the sun's rays pierce only with difficulty.

Three closely related ferns we expect to meet with in the vicinity of one of the many waterfalls whose sides, green with mosses, are kept constantly wet by the spray from the water, as it dashes over the rocks. The ferns referred to are the two Filmy Ferns and the Bristle Fern. So delicate and membranous, or thin, are the fronds of these ferns that they cannot exist under natural conditions, except in situations where their fronds are being continually sprayed by falling water. These three ferns differ from all other British ferns in possessing indusia, either urn-shaped or split into two valves, which are seated at the margins of the fronds. Within these strange indusia the capsules are clustered round the ends of the veins which project into the indusia. In the case of the Bristle Fern the veins project beyond the indusia, forming the so-called bristles to which the fern owes its popular name.

The Bristle Fern is one of the very rarest of British ferns. Though fairly plentiful in some parts of Ireland, particularly Killarney, it has been recorded only from a very few localities in the United Kingdom. Thus, were it not that our wood is an imaginary one, we might search long for it to very little purpose.

The long, softly hairy, blackish rhizome of this fern creeps widely over the well-moistened moss-covered rock. Its leafstalks have wing-like margins at the top but are quite bare at the bottom, where they are jointed to the rhizome. The leafy part of the frond, varying from 2 to 12 inches in length, has been well described as simply consisting of a much-branched midrib with a membranous wing. In reality it is three or four times pinnate with strong, well-marked veins, and narrow, toothed, and pellucid pinnules. The position and nature of the urnshaped indusium, the projecting spike or bristle, and the membranous character of the frond are sufficient marks by which this fern may be readily recognised.

Botanically, this fern is known as *Trichomanes radicans*. The generic name has been explained as though derived from two Greek words meaning "hair" and "excess." The bristles which project from the urn-shaped indusia may have the appearance of hairs, but it is nevertheless exceedingly doubtful if the etymology suggested is the correct one. But as no other has been put forward, there the matter remains for the present. *Radicans* is evidently connected with

the Latin *radix*, "a root," and is probably a reference to the very long, extensively-creeping rhizome.

On the rocky sides of the waterfall we must search diligently for the two Filmy Ferns. As they are the smallest of British ferns, resembling more some of the mosses among which they grow than the ordinary type of ferns, they must be carefully sought for with an exact knowledge of what we are seeking, or they will escape our observation. They may frequently be found growing together, and it is only by attention to small points of difference that they can be distinguished from each other.

One easy test for distinguishing the Tunbridge Filmy Fern from the One-sided Filmy Fern is the presence of teeth on the lips of the cup-shaped indusium of the former, and their absence on the similarly shaped indusia of the latter. Another and, perhaps, a more reliable test is that in the first-named fern the pinnæ, the leafstalks, and the indusia all lie in one plane, while the One-sided Filmy Fern has its indusia set almost at right angles to the fronds, the pinnæ of which curve backwards and give the one-sided appearance to the fern, to which it owes its specific name.

Both ferns have very thin threadlike rootstocks which frequently become interlaced, as these ferns generally grow in colonies. Both also have the semi-transparent membranous fronds with prominent veins that we noted in the Bristle Fern.

Let us now examine the two ferns in more detail.

The Tunbridge Filmy Fern has fronds of an olive-brown colour, in the wild state seldom more than 3 inches long, and appears to the casual observer as if in a withered and dying condition. These fronds are more or less distinctly divided into toothed and lobed pinnæ.

To botanists it is known as *Hymenophyllum Tunbridgense*. The generic name is derived from two Greek words, *hymen*, "a membrane," and *phyllon*, "a leaf," which is evidently a reference to the texture of the fronds. *Tunbridgense* is formed from Tunbridge, and the fern is so-called because it was first recorded from that district.

The One-sided Filmy Fern is regarded by some botanists simply as a subspecies of the former fern, but the important points of distinction already referred to appear to entitle this fern to the rank of a distinct species. Then there are minor differences which are also worthy of consideration. The fronds of the One-sided Filmy Fern are coarser and of a darker hue than the fronds of its near relative, and more able to stand exposure to sunlight. The former fern, too, is generally pinnate throughout, though occasionally only pinnatifid at the top, with the pinnæ lobed and toothed on the side nearest the tip of the frond. The scientific name of the One-sided Filmy Fern is *Hymenophyllum unilaterale*. *Unilaterale* is a Latin word meaning "one-sided," and the reason for its application to this fern has already been stated. The word "filmy" is explained

PLATE 10

(1)

(2)

(1) Fir Clubmoss

(2) Common Clubmoss

when we think of the texture of the fronds of these two ferns.

Leaving our woodland with a backward glance of regret, we catch a glimpse of that fern, the Common Hart's Tongue, which we have known all our days, it being a prime favourite with the housewife, who values it because of the evergreen nature of the fronds and its hardy constitution. But, however much we may have admired it in a flower-pot, we have to admit that it appears more beautiful amid its natural surroundings, with its drooping fronds hanging gracefully over the bank which borders the wood.

The rootstock of this fern is thick and short, and the fronds, when mature, are dark green in colour and rather leathery. These entire fronds, with wavy margins and heart-shaped bases, are strap-shaped in outline and taper away to a point. An entire, that is, uncut frond is a very unusual feature in British ferns. The midrib is very prominent, and from it spring at right angles nerves or veins which can be easily made out with the naked eye. The sori which are most plentiful towards the tapering end of the frond appear in lines parallel to the veins, but they are really double sori. A pair of sori are joined edgeways and covered with linear indusia, which seem at a certain stage of growth as a single indusium, but, if carefully examined, they are found to be two and not one. These twin sori, as they are called, with their twin indusia which open opposite each other, are the distinguishing marks of the genus

Scolopendrium, to which the Hart's Tongue Fern, the only British representative of the genus, belongs.

A very considerable number of varieties of this fern have been cultivated, some having a very remarkable appearance. Even in the wild state, this fern has a tendency to produce abnormal fronds, with the tips forked or branched. It is named *Scolopendrium vulgare*. The generic name is formed from *scolopendra*, a "centipede," from a fancied resemblance of the linear sori to the feet of the centipede. *Vulgare* is, we already know, Latin for "common."

CHAPTER VI

FERNS OF THE MOORS AND MOUNTAINS

On our last visit to the homes and haunts of ferns, we direct our footsteps to the uplands. Along the stony byways, over the solitary moors, and up the precipitous slopes of the mountains, we wander with eyes keen to detect those ferns which delight in such situations.

The first to thrust itself upon our attention is the Bracken, or Common Brake, the commonest of all British ferns. This fern seems to have adapted itself to present-day conditions more readily than any other of our native ferns, covering large areas with its tall, branching fronds, and ever extending its dominions, invading the pasture-land, and even colonising the barren stretches of sand along our coasts. Probably,

it was originally a fern of the woods, where it may still be found in abundance, but it is now quite as much at home in the most exposed situations. Because of its wide distribution and abundance, the Bracken has never received that share of admiration to which its beauty and elegance of form entitle it. Indeed, it is too often contemptuously passed over by the ignorant as unworthy to be ranked as a true fern.

The Bracken belongs to the genus *Pteris*, which is characterised by the linear sori arranged in a continuous line all round the margin of the frond, the recurved edges of which conceal the thin, dry indusia. It is the only British fern of this genus.

The underground rootstock of the Bracken is thick, and, in old specimens, of great length. The stout leaf-stalks, dark towards the base, are often 3 or 4 feet in height, and are furnished with rather sharp edges. In badly-grown or stunted specimens the fronds appear to be three-branched, but in well-developed forms they are seen to be thrice or even four times pinnate. At the very tip of the frond the pinnæ are entire, a little lower they are pinnatifid, towards the middle they themselves are pinnate with pinnatifid pinnules, while the lowest pinnæ of all may be twice or thrice pinnate, with the ultimate frond-segments pinnatifid and stalkless.

Many and varied were the uses to which the Bracken was formerly put. Apart from its medicinal virtues, it was specially valued because of the alkali contained in

its ashes. For this reason old-time glass and soap-makers found it suitable for their purposes. And to-day farmers and cottars still harvest it to provide bedding for their cattle. Fish, fruit, and flower dealers also find that it makes an excellent packing material. Gamekeepers, too, encourage its dense growth, as its wide-spreading foliage makes good cover for game. But we who esteem it most because of its beautifying effect on our hillsides and moors may rejoice to know that we have in the Bracken one fern which is in no danger of being exterminated.

The scientific name of the Bracken is *Pteris aquilina*. *Pteris* is Greek for "fern," and *aquilina* is formed from the Latin word for "an eagle"—viz., *aquila*.

If the leafstalk be cut across, the section of the woody vessels thus disclosed is said to resemble an eagle with outstretched wings. This fancied resemblance—much more fancied than real—is responsible for the application to the Bracken of the specific name, *aquilina*.

As we proceed higher up the mountain-side, we are delighted to discover the Parsley Fern growing amid the loose stones, or peeping from the crevices of a dry-stone dyke. At a first glance we are quite ready to admit the appropriateness of the popular name, for the light green leafy fronds are not unlike tufts of the cultivated parsley of our gardens.

Its rootstock is scaly and closely beset with the bases of former fronds, the fronds which are of two kinds,

Fertile Stems of Field Horsetail

Smooth Naked Horsetail

PLATE 11

barren and fertile, perishing annually before the rigours of winter. The barren or leafy fronds which grow on the outside of the tufts are twice or thrice pinnate, the pinnules, like the whole frond, being roughly wedge-shaped or triangular, and cut into two lobes. The leaf-stalks are thin, brittle, and light brown in colour. The fertile (spore-bearing) fronds are slightly taller than the barren ones, and spring from the centre of the tufts. Like the barren ones, they are also twice or thrice pinnate, more often thrice, and roughly triangular in shape, but the pinnules are rather oblong than wedge-shaped. In the early stages of growth the sori are roundish, but later on they form two almost unbroken lines round the edges or margins of the pinnules. These margins, being recurved, hide the very fine indusia. The globular sori which eventually unite to form lines, the recurved margins of the fronds under which the sori are almost concealed, the fine indusia, and the two dissimilar fronds are the distinguishing marks of the genus *Cryptogramme* to which the Parsley Fern belongs. *Cryptogramme crispa* is the full botanical name of this fern. The generic name is formed from the Greek words, *kruptos*, "hidden," and *gramme*, "a line," because the sori, when mature, form lines round the frond margins. Its specific name is an allusion to the curled appearance of the fronds.

In the same stony region, on a ledge of rock, we encounter the Brittle Bladder Fern. This fern and its near relative, the Mountain Bladder Fern, belong to

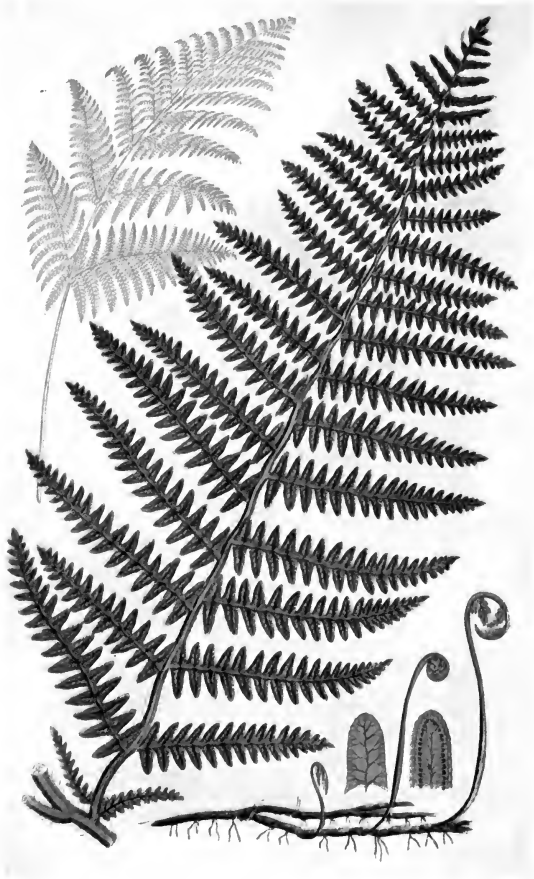
the genus *Cystopteris*, whose distinguishing mark is the very fine-toothed indusia, swollen or inflated near their centre, covering the small globular sori. These indusia are ovate in shape, and are attached to the frond by their bases below the sori, over which they form a kind of hood, tapering away to a toothed point. When the spores are ripe the indusia are reflexed. *Cystopteris* is formed from the Greek word *kystos*, "a bladder," and *pteris*, Greek for "fern." "Bladder" is a reference to the inflated centres of the indusia.

Both ferns of this genus are very delicate in texture, the membranous character of the fronds being alone sufficient to distinguish them from all other mountain ferns.

The small fronds of the Brittle Bladder Fern, which are about 6 inches in length and lanceolate in outline, grow in tufts from a rootstock clad with almost transparent brownish scales. These fronds are once or twice pinnate, the pinnæ having wedge-shaped bases and being about 1 inch long. The pinnules are cut into toothed lobes.

This fern is named *Cystopteris fragilis*. It owes its specific name to the delicacy and fragile nature of its fronds, *fragilis* being a Latin word meaning "easily broken."

There are one or two varieties of this fern distinguished from each other by their more or less finely-cut leaf segments. Many botanists, however, are unwilling to declare them distinct species.



COMMON BRACKEN
(*Pteris aquilina*).

The Alpine Woodsia

The Mountain Bladder Fern is only to be sought for on wet rocks in mountainous districts. Its black, creeping rootstock, from which the fronds arise at intervals, is furnished with a few scales. The pale green, wedge-shaped fronds, borne on very slender leafstalks, are very finely divided, being three or even four times pinnate. The pinnules are also deeply cut or lobed. In length the fronds are about 6 inches from the lowest pinnæ to the tip of the frond, and at the base are almost as broad as long. It is one of the rarest of British ferns. It bears the name of *Cystopteris montana*. *Montana* is an adjective, formed from the Latin *mons*, "a mountain," and the fern is so named because of its habitat.

Another of the very rarest of our native ferns, to be found only on the wet ledges of rocks in very elevated regions, is the Alpine Woodsia.

The sori of this fern are at first covered by a very thin indusium, which latterly splits into hairlike segments, so that the spore capsules appear as if springing from a cluster of hairs. There is only one native fern of the genus Woodsia, easily recognized by the torn indusia. It may be well to mention, however, that a variety of it is regarded by some botanists as a distinct species. This fern, *Woodsia hyperborea* by name, which is from 2 to 4 inches in length, springs from a very thickly-tufted rootstock. Its glossy leafstalks are clad with rusty scales and jointed a little above their point of connection with the rootstock. The leaves break off

at this joint when their time of activity is over, so that the growing extremity of the rootstock is always surrounded by the bases of the leafstalks of former seasons. The fronds are once pinnate, the lower pinnæ being alternate and divided into roundish segments, which are slightly hairy, especially on the under surface.

Woodsia is a name given to this fern in honour of J. Woods, an eminent English botanist. *Hyperborea*, meaning "belonging to the extreme north," is formed from the Greek *hyper*, "beyond," and *Boreas*, "the north wind." The reference in the specific name is to the Arctic or semi-Arctic distribution of the fern.

On the same wet rock we may meet with a fern with a very striking resemblance to the Maidenhair Spleenwort, *Asplenium Trichomanes*, described in Chapter III.; indeed, so remarkable is the resemblance that some botanists hesitate to rank it as a species at all, and content themselves with calling it a variety of the fern which it so much resembles. The fern referred to is the Green Spleenwort, so called because of the very pale green colour of the leaves, the midribs, and the upper parts of the leafstalks. It may be quite easily differentiated from its near relative, the Maidenhair Spleenwort, by its green midribs and leafstalks. If the searcher be already acquainted with *Asplenium Trichomanes*, no further description is required to lead to the identification of this fern. Its scientific name is *Asplenium viride*. *Viride* is Latin for "green."

As we toil slowly upwards to the highest peak of our

mountain we examine carefully every cleft on its rocky side in expectation of finding the Holly Fern. It is one of the Shield Ferns, which are all included in the genus *Aspidium*. The leathery and rigid fronds of this fern, which are seldom more than 1 foot in height, spring from a very thickly-tufted rootstock. They are simply or once pinnate, and attached to very short leafstalks covered with rust-coloured scales. The pinnæ, which are ovate in shape, have an ear-shaped lobe at their base on the side nearest the tip of the frond. The bright, glossy-green colour of the fronds and the spiny teeth set all round the margins should be carefully noted, as the fern may be readily identified by these features alone. The only respect in which the fern can be said to resemble holly, even remotely, is in the possession of the spinous teeth just mentioned.

Botanists refer to this fern as *Aspidium Lonchitis*. *Lonchitis* is derived from a Greek word, *lonche*, a "spear-" or "javelin-head," and the allusion is either to the spines or to the general outline of the frond.

Near the Holly Fern, on a shaded ledge of rock, we note the Alpine Polypody. This fern bears a remarkable likeness to some forms of the Lady Fern, for which it may readily be mistaken, but the naked circular sori have caused it to be included among the Polypodies. The rootstock is thick, tufted, and scaly. The leafstalks, which are about $\frac{1}{2}$ foot long, are covered with scales, especially towards the base. The fronds, varying from 1 to 2 feet according to the altitude at

which they grow, are twice pinnate, the pinnules being very pinnatifid and provided with teeth. The pinnæ, which taper away from the rachis to their extremities, extend almost to the foot of the leafstalks.

The Alpine Polypody is confined to the Highlands of Scotland. Its botanical name is *Polypodium alpestre*. *Alpestre* is Latin for "alpine," a name applied to this fern because it is confined to very elevated regions.

On our descent from the mountain we must not pass unnoticed the ferns which abound on its heathery slopes, on the banks of its rills, and on the almost bare pasture-land nibbled close by the sheep.

Among the heather grows the Mountain Buckler Fern. Its lanceolate fronds, which spring from a tufted rootstock, are borne on very short and scaly leafstalks. They are once pinnate, with the pinnæ pinnatifid and continued down the midrib almost to the rootstock. On the back of the frond we detect innumerable glands, which emit a rather pleasant odour when the fern is drawn through the fingers. The sori are placed near the margins of the fronds, and are covered with very fine indusia, which finally drop off. The Mountain Buckler Fern is not a difficult one to make out, if attention be paid to the yellowish-green colour of the fronds, to the lowest pair of pinnæ at the base of the leafstalks, which are always very small, and to the very numerous glands on the underside of the fronds.

As its name *Nephrodium oreopteris* implies, it is a member of the genus *Nephrodium*. Its specific name is

formed from *pteris*, "a fern," and the Greek *oros*, "a mountain," hence *oreopteris* may be translated as Mountain Fern.

If our mountain happens to be in the neighbourhood of Lancashire, Westmorland, Yorkshire, or the adjoining counties, we are likely to meet with the Rigid Buckler Fern; but if not, we may consider ourselves fortunate if we succeed in discovering it elsewhere, for, as far as is known, it seems to be almost entirely restricted to the localities mentioned. The triangular or lanceolate fronds, supported on strong and very scaly leafstalks, grow in tufted fashion. These fronds, which are about 1 foot in length, are bipinnate, with lobed and toothed but not spiny pinnules. Like the last fern described, the under surface of the fronds of the Rigid Buckler Fern is covered, but not so densely, with glands. The indusia, which are fringed with glandular hairs and which do not fall off as the spores ripen, are placed near the midrib, and not at the margins, like those of the Mountain Buckler Fern.

It is called by botanists *Nephrodium rigidum*. The specific name *rigidum*, which is a Latin word meaning "stiff," was bestowed on this fern, because, unlike the majority of our native ferns, it maintains a very erect posture, the fully expanded fronds bending neither to the one side nor the other.

Another rare but more widely distributed fern, giving forth when bruised a very pleasant odour, is the Hay-scented, or Triangular Buckler, Fern. A very short

description of this fern only need be given, as it can be quickly recognized from one feature alone—namely, the upturned margins of the fronds, which give the fern quite a curled or crisped appearance. This upward curling of the margins also renders the upper surface of the fronds concave, another feature useful as a guide to its identification. The rootstock is tufted, and bears reddish leafstalks, covered with scales torn at the edges. The fronds are twice pinnate. As the lowest pair of pinnæ are longer than those above, and as each succeeding pair decreases in size, the frond has a triangular shape, from which feature it takes one of its popular names. Its alternative common name requires no explanation. On the under surface of the fronds are the little glands similar to those of the preceding ferns. The botanical name of this fern is *Nephrodium æmulum*. *Æmulum* is a Latin word meaning "comparable with," a reference to this fern's similarity to *Nephrodium spinulosum*, of which many botanists regard it as a mere variety.

On turning our faces homeward, we are sure to notice the Hard Fern nestling at the base of a clump of heather, or among the low bushes which fringe the banks of the mountain rills. It is one of the best known and commonest of British ferns, and is the only representative in this country of the genus *Lomaria*. The chief mark of this genus is the linear sori on the recurved margins of special spore-bearing fronds. This curving of the margins partly conceals the thin dry indusium which is thus apt to be overlooked. The

ordinary leafy fronds, which bear no spores, are either spreading or upright in growth. They are smooth, dark green, leathery, and evergreen. Because of the hard leathery texture of the leafy fronds and of their evergreen nature, the fern has come to be regarded as a hardy plant, which it truly is, if we compare it with almost any native fern. We must admit, then, that the common name of this fern is a very appropriate one.

Examining again the non-spore-bearing, or barren, fronds, we see that they are placed on the outer circle of the tufts, and that they are pinnate at the base, but only pinnatifid at the tip. The spore-bearing, or fertile fronds occupy the centre of the tufts. They are distinctly taller than the barren fronds, are always erect in posture, and are once pinnate with the lower pinnæ some distance apart from each other. The cutting, or divisions, of the fertile fronds have been well compared to the teeth of a comb. The sori, as already described, are very abundant, covering the entire under-surface of the pinnae.

Like most well-known and widely distributed ferns, the Hard Fern had long ago a reputation for its medicinal virtues, being esteemed of great service in treating diseases of the liver.

Its scientific name is *Lomaria spicant.* *Loma* is Greek for "hem," or "border," an allusion, perhaps, to the continuous marginal sori, while *spicant* is derived from the Latin *spica,* a point, and is doubtless applied to this fern because of the pointed toothlike pinnæ.

CHAPTER VII

CLUBMOSSES AND THEIR RELATIVES

To young botanists it always comes as a great surprise to learn that the lowly clubmosses are closely related to ferns, to which outwardly they bear no resemblance whatever. This feeling of surprise vanishes, when the marked similarity in their life-histories is made clear. Both may be traced back to a spore, which, on germinating, produces a prothallium, from which, later on, springs the new plant. But in the case of some of the clubmosses it may be well to note that the spores take years to germinate, and that a further interval of years elapses after the production of prothallia, before the male and female organs are developed.

Most of these prothallia, too, unlike those of ferns, are produced under and not on the surface of the soil. In all other respects ferns and clubmosses are very dissimilar. Ferns possess, as a rule, large deeply divided leaves, while clubmosses have short, entire leaves closely arranged round the long, creeping, and forked stems. In ferns the spore capsules are borne in clusters on the backs or edges of the fronds, but in clubmosses they appear singly, either at the bases of the ordinary leaves or on special leaflike bracts clustered together on an erect stalk to form the so-called "cone." The single capsules, which are large compared with those of ferns,

HARD FERN
(*Lomaria spicant*).

open by valves. The spores are very minute, but extremely numerous. Under the name of Lycopodium Powder they were formerly much used in firework displays on account of their inflammable nature. They have also been used as a waterproof coating for pills, because of their peculiarity in remaining dry when exposed to a moisture-laden atmosphere.

Clubmosses have, in the shape, size, and arrangement of their leaves and in their prostrate habit of growth, a strong likeness to true mosses, and to this they owe the latter part of their popular name. The prefix, "club," is said to be due to the resemblance of the spore-bearing cone in some of the species to a club. The resemblance, however, is not a striking one.

The British clubmosses are all included in the one genus, *Lycopodium*, which is the sole British representative of the Clubmoss Order of plants. *Lycopodium* (Greek *lukos*, "a wolf," and *pous*, "a foot") may be freely translated as Wolf's Claw, one of the popular names given to the commonest species, owing to its method of branching; but here, again, it requires a very vivid imagination to see the resemblance between the forked stem and a wolf's claw.

There are only five native clubmosses found in British Isles, or six, if we include the Lesser Alpine Clubmoss, which, however, has now been relegated to another group of plants, after having been for long regarded as a *Lycopodium* or clubmoss.

Our native clubmosses are mostly plants of the

upland moors and mountains, though they are occasionally to be found at much lower levels.

The best known and commonest clubmoss is *Lycopodium clavatum*, the Stag's Horn Moss, Common Clubmoss, Wolf's Claw, etc. Unless in autumn when the fruiting spikes, cones, or clubs appear, it is by no means easy to locate this plant, and thus it often escapes notice, though it is by no means rare. It has long, strong, creeping and branching stems, densely clothed all round with small, overlapping, and lanceolate leaves, ending in fine hairlike points. This hairlike point at the end of the leaf is alone sufficient to distinguish *Lycopodium clavatum* from the other species. At intervals the creeping stems are fastened to the ground by strong roots, and in late autumn slender upright branches appear, at the tops of which the cones or clubs develop. These cones are composed of leaflike bracts, at the bases of which are the capsules, one to each bract. When the spores are discharged, the bracts wither and drop off, although the main stem remains green during winter unless in the most exposed situations.

Rustics often adorn their persons and their houses with the Common Clubmoss, and in Sweden mats have been woven from the stems.

The specific name of this clubmoss is derived from the Latin *clava*, "a club." The reference is to the cone, or club, bearing the spores.

The Fir Clubmoss, *Lycopodium Selago*, is almost as well known as the Common Clubmoss, and it is very

much easier to locate, because, unlike the other native clubmosses, it is upright and not prostrate in growth. The popular name of this clubmoss is a very appropriate one. Seen on the rocky slopes of mountains or on elevated moorlands with the sun shining on its dark green foliage, the plant bears quite a striking resemblance to the early stages of some of our coniferous trees.

Its upright growth and the absence of special spore-bearing branches at once mark it off from the other native clubmosses. The stem may be for a short distance prostrate, but when branching takes place, the branches become upright. The leaves, which are small with pointed tips, cover every part of the branches from top to bottom. The spore capsules are to be found in the axils of the upper leaves and not in special spikes or cones.

This plant may also be reproduced by budding. At the top of the branches little buds appear. When these have reached a certain stage of development, they are scattered in all directions as the branches are tossed about by the wind. On finding a suitable soil, the buds take root and grow into new plants.

The Fir Clubmoss is only found in elevated situations. *Selago*, the specific name of this plant, was formerly the generic name of all the clubmosses, and is believed to have been the name of some unknown ancient plant to which, perhaps, the Fir Clubmoss bore a strong resemblance.

The Marsh Clubmoss, *Lycopodium inundatum*, is found, as its name implies, in marshy places, which are liable to be flooded at times. Edges of bogs, swampy ground, and moist, peaty lands are its favourite habitats. The roots of this species are very short, but numerous, and it is quite impossible to collect the plant without taking the sod as well, so closely does it cling to the soil. It dies down during winter, with the exception of the growing tip, so that the plant, when found, is seldom more than 2 or 3 inches in length. The leaves are small, and have the appearance of growing only on one side of the stem, though they are really set all round it. In addition to the prostrate stem there are also upright branches as in the Common Clubmoss. These branches have spindle-shaped heads with lanceolate bracts toothed at the base.

The name, *inundatum*, points out that this clubmoss delights in places that are subjected to periodic flooding.

The Alpine, or Savin-leaved, Clubmoss, *Lycopodium alpinum*, is a plant restricted to mountainous districts. It has long, creeping, and much-branched stems, which bear short, forked, and upright branches. The prostrate stems are rather bare of leaves, but the upright branches are covered with small, lanceolate, overlapping leaves, terminating in a point. The peculiar bluish green colour of the leaves readily distinguishes the Alpine Clubmoss from the other native species. Some of the erect branches are barren,

and some, fertile, the latter, which bear the cones at their extremities, being the longer.

This clubmoss, which remains green during winter, often covers considerable areas on the mountains of Scotland with its branching stems.

The specific name, *alpinum*, is an allusion to the habitat, and the common name, Savin-leaved, calls attention to the resemblance of this clubmoss to a plant, Savine, or *Juniperus Sabina*, by name.

The Interrupted Clubmoss, which like the last-named species is confined to the stony mountain slopes, is much commoner in Scotland than in any other part of the kingdom. At a first glance it seems to resemble greatly the Common Clubmoss, but the peculiar feature to which it owes its common name renders it easy of identification. This is the possession of leaves much smaller and less spreading than the normal forms, and arranged at regular intervals on the erect branches. The foliage of the upright stems seems, as it were, to be interrupted or constricted at certain points. These points really mark the beginning of each year's growth, hence the specific name, *annotinum*, which is a Latin adjective signifying "a year old."

As in most clubmosses, the prostrate stems have erect branches, some fertile, and some barren. At the head of the fertile branches are the cones with leafy bracts, at the bases of which the spore capsules are set. The leaves proper, which are narrowly lanceolate in outline, have toothed margins. But the best guide to the

identification of this clubmoss "in the field," as already pointed out, is the so-called interruptedness in the foliage of the upright branches.

The Lesser Alpine Clubmoss, *Selaginella spinosa*, though still popularly called a clubmoss, is no longer to be regarded as a true *Lycopodium*. For a reason to be immediately stated, it is now placed in a different order or group of plants which we may call the *Selaginella* Order.

The *Selaginellas* differ from the clubmosses in producing two different types of spores, a larger type and a smaller type. The large spores are enclosed in comparatively large spore capsules, three or four to each capsule, while the very numerous small spores are crowded into much smaller capsules. The smaller capsules, with their very minute spores, are more numerous than the larger capsules. The large spores produce prothallia with female organs only, while the smaller produce the male elements necessary for the fertilisation of the egg-cells in the female prothallia.

Our only native *Selaginella*, the plant referred to above, is a much more delicate-looking plant than the true clubmoss. It has prostrate and upright stems. Some of the latter are barren, while others contain the spore capsules in the axils of the tiny spinous leaves, which are of a delicate and transparent texture.

Though this plant is by no means rare, it often escapes the observation of even the keenest of botanists, owing to its small size and to its very strong re-

semblance to the true mosses. It flourishes best on marshy grounds, and is to be found in the drainage cuttings on the hills and moorlands and on the marshy stretches of our shores.

Selaginella is formed from *Selago*, to which reference has already been made when describing the Fir Club-moss, and means, literally, "little Selago"—that is, "little clubmoss." The specific name, *spinosa*, refers to the small teeth on the margins of the tiny leaves.

Two other plants allied to ferns and clubmosses may be mentioned here—namely, the Quillwort and the Pillwort, or Pepperwort, both of which are aquatic plants, the former growing at the bottom and the latter at the edges of lakes and ponds.

The Quillwort, *Isoetes lacustris*, is a plant only to be found in mountain lakes and tarns. It grows from a tuberous rootstock guarded by the bases of former leaves. The brittle, dark green, and quill-like leaves, which are about 3 inches in length and number from ten to twenty, spring in tufted fashion from the rootstock. They are roughly quadrangular in shape, and taper away to a sharp point. Concealed within the sheathing leaf-bases, and attached to the leaves themselves, are the two sets of spore capsules, containing large and small spores respectively. Those containing the large spores are attached to the leaves of the outer rows, while those containing the small spores are to be found within the inner circles of leaves. The possession of large and small spores, with their subsequent development into

female prothallia and male spermatozoids, links the Quillwort to the *Selaginellas*.

There are two British species of Quillwort, but, as the second is confined to the Channel Islands, it is omitted here. The name, *Isoetes*, is derived from the Greek *isos*, "equal or similar," and *etos*, "a year," and is applied to the Quillwort, because it is an evergreen plant. *Lacustris*, the specific name, is from the Latin *lacus*, "a lake"—a quite evident reference to the plant's place of growth. The popular name of the plant is due to the remblance of the awl-shaped leaves to quills.

The Pillwort, or Pepperwort, the only native representative of the true Waterferns, also produces larger spores and smaller spores, but both are produced in the the same capsule, which is four-celled, and about a quarter of an inch in diameter.

The creeping rootstock, which is only a little thicker than a stout thread, is about 6 inches in length. From it spring at intervals the bright-green, threadlike leaves, 2 or 3 inches in length. When young they are coiled like young fern fronds, but when mature they straighten up. The spore capsules, which are situated at the points on the rootstock from which the leaves arise, are shortly stalked and covered with brown hairs.

The Pillwort is rarely met with in water or any depth, preferring the margins of ponds, ditches, and marshes subject to occasional floodings.

PLATE 14

Barren Stems of Field Horsetail

Summary

This plant is known to botanists as *Pilula globulifera*. Both generic and specific names refer to the small pill-like or globular-shaped spore capsules. *Pilula* is a Latin word meaning "a little pill." *Globulifera* is also a Latin word, formed from *globus*, "a globe or ball," and *fero*, "I carry." The common names, Pillwort and Pepperwort, also refer to the spore capsules which have been compared to pills and peppercorns, the latter being the fruit of the pepper plant.

To sum up :

1. Clubmosses are closely allied to ferns. The relationship lies in the similarity of their reproductive processes. In outward appearance they resemble the true mosses. Only five species of clubmosses are found in Britain to-day.

2. The *Selaginellas* are represented by one native species only. This group of plants is distinguished from the clubmosses by the production of two sets of spores, smaller and larger, giving rise to male and female elements respectively.

3. The Quillwort is a near relative of the *Selaginellas*. It, too, possesses spores of two kinds producing the male and female organs. It is aquatic in habit, and is to be found in the deeper parts of lakes.

4. The only native Waterfern is the Pillwort. It also is closely related to the *Selaginellas*, possessing the same two types of spores. Both types are to be found, in the case of the Pillwort, in the one capsule.

CHAPTER VIII

HORSETAILS

LIKE clubmosses, horsetails show no apparent outward resemblance to ferns, to which they are related. They consist of upright stems in the form of hollow cylindrical tubes solid at the nodes. These stems are leafless, unless the toothed sheaths which spring from the nodes be regarded as modified leaves. In most cases the stems are branched, the branches, which are solid throughout, being given off in whorls from the base of the sheaths. Two of our native horsetails have barren and fertile stems quite distinct in appearance. The remaining six British species have both barren and fertile stems nearly alike and only to be distinguished by the latter bearing cones. In all the species, the cone consists of a series of whorls of stalked scales, to each of which are attached five or six little capsules filled with spores. The stalks of the scales stand at right angles to the axis of the cone, the axis being simply an elongation of the original stem. The scales are of an irregular hexagonal form, and in the young state are so close together that the interior of the cone is perfectly protected from the effects of the weather. As the spores mature, the axis lengthens and the scales separate from each other. Then the spore capsules,

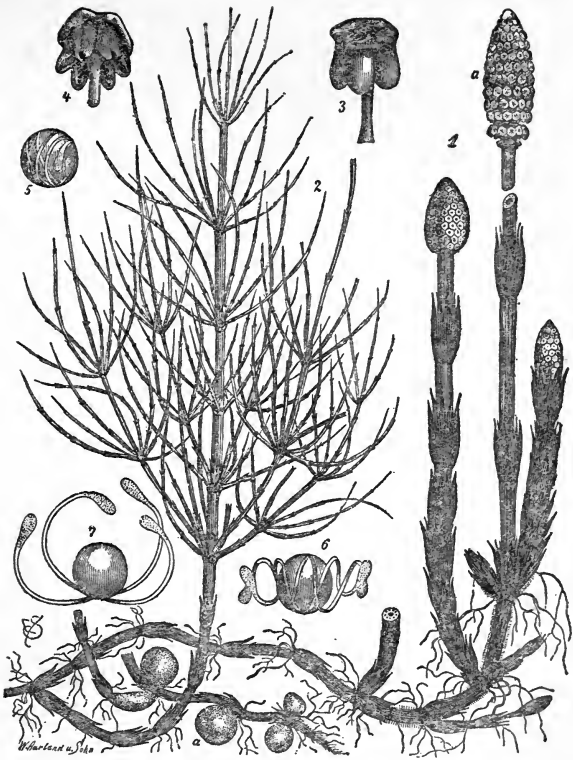


FIG. 4.—"EQUISETUM ARVENSE." (AFTER WOSSIDLO, FROM STRASBURGER.)

From "An Introduction to Structural Botany," by D. H. Scott.

1 and 2, General view of plant, showing underground rhizome, bearing roots, with fertile and barren upright stems. 1, Fertile stems; *a*, ripe cone. 2, Much-branched barren stem; *a* (on rhizome), tubers. 3, Single stalked scale from cone, showing spore capsules. 4, Similar scale from below; sporangia splitting. 5, Young spore, with elaters not yet expanded. 6, Mature spore in damp condition; elaters curled up. 7, The same in dry condition; elaters expanded. Figs. 1 and 2 reduced; Figs. 3 and 4 magnified slightly; Figs. 5, 6, and 7 very highly magnified.

which hang from each scale, rupture, and the spores are liberated.

The stems, which are marked by longitudinal ridges and hollows, abound in flinty particles. Owing to the presence of these flinty particles, horsetails were once much utilised in the polishing of marble, metal goods, woodwork, etc., especially one species, popularly called Dutch Rushes, which is still exported from Holland for that purpose.

In addition to the upright stems there is a much branched underground stem, or rootstock, which by choking up drainage cuttings and ditches often proves exceedingly troublesome to farmers and others.

Horsetails are allied to ferns in that they, like ferns, are reproduced indirectly from spores with the intervention of a prothallium stage. The prothallia, however, are of two kinds, male and female, the former bearing the male organs only, and the latter, the female, Both kinds of prothallia are produced from similar spores, and the question as to whether a spore will become a male or a female prothallium seems to depend on the nutriment present when the spores germinate. These spores which are very minute and of a light-green colour have a very interesting property. If they be shaken from the cone on to a sheet of white paper, they instantly jump about, as if alive, but, if a few drops of water from a pin-point be dropped upon them, they become quiescent at once. Their power of movement may be even better noted, if a few of the moist

spores be collected and viewed through a microscope. The cause of the movement, too, will be at once apparent. Four fine threads with clubbed ends are seen attached to the spore. If a drop of moisture be now placed on the spore, the threads will become invisible and will remain so, till the spore again becomes dry, when the threads will once more uncoil. These threads when not expanded are coiled round the spore. What purpose the threads, or elaters, as they are called, serve is not exactly known.

Railway embankments, the margins and shallows of ponds and marshes, ditches, roadsides, moist woods, and stiff, poor soil are the favourite habitats of horsetails with us.

The British horsetails, eight in number, all belong to one genus, *Equisetum*. The popular name, horse-tail, is almost an exact translation of the botanical *equisetum*, a word derived from *equus*, "a horse," and *seta*, "a bristle." The resemblance of the upright stems, more particularly the fertile stems of those species which have two distinct forms, to a horse's tail is alleged to be the reason why this plant is so named, but the resemblance is by no means a striking one. The best known horsetail is the Field Horsetail, or Cornfield Horsetail, *Equisetum arvense*.

It grows plentifully on railway embankments and roadsides, and it is very frequently found in pastures and cultivated land, more especially on sandy soil. Early in spring it sends up from a much-branched

rootstock an erect, fertile stem, bearing at its extremity the characteristic yellowish cone. This stem, which is rarely branched, is succulent, smooth, yellowish-brown in colour, and from 3 to 7 inches in length. It bears four or five loose sheaths ending in pointed teeth, with thin light brown margins. After the spores are scattered by the wind, the fertile stems decay and are succeeded by the barren vegetative ones, which may be either erect or almost prostrate. The later stems when mature are crowded with whorls of spreading branches which in their turn may also be branched. Towards the top the main stem tapers away to a long point without leaves. Both stems and branches are rough to the touch, owing to the flinty crystals which abound on their surfaces. The stem is marked by many ridges and furrows, which vary in number, but the branches are definitely four furrowed and possess sheaths all four toothed.

It should be noted that the barren and fertile stems are quite distinct in the Field Horsetail, not only in appearance, but also in the times at which they emerge from the soil. Although appearing in pastures, this plant appears to be avoided by cattle on account, perhaps, of the flinty particles referred to above.

Arvense is a Latin adjective derived from *arvus*, "a field," and is applied to this horsetail because, unlike the other native horsetails, it often appears as a weed in dry pastures.

At a first glance our next species, the Blunt-topped

The Shade Horsetail

or Shade Horsetail, *Equisetum pratense*, appears not unlike the Field Horsetail. There are a few outstanding points of difference, however, worthy of notice. The former plant is much rougher to the touch than the latter. Its ridges and furrows and its whorls or branches are also much more numerous. Its stems, too, are of a lighter and more beautiful green.

Again, it is a plant to be found only in marshy meadows, moist shady woods, and other wet places. This horsetail has three kinds of stems. The first, or fertile stem is short, but the loose, yellowish, sheaths are comparatively large, often quite concealing the stem. The second, or barren, stem, which may reach a height of 2 feet, has about twenty well-marked ridges, and numerous branches towards the top. There is no long tapering end bare of leaves as in the Field Horsetail. On the contrary, the top whorls of slender branches spreading upward reach the top of the stem, and give the flat-topped appearance to which the plant owes its common name. The sheaths, with about twenty teeth, are much smaller than those of the fertile stems. The slender branches are three or four ridged, and bear sheaths with three or four teeth. The third type of stem, the fertile-branched stem, is larger than the fertile, but smaller than the barren one.

The name, Shade Horsetail, is a reference to one of the plant's habitats—namely, moist, shady woods, while Blunt-topped is descriptive of the appearance of the barren stem due to the upward spreading of the leaves.

Pratense is a Latin word meaning "growing in meadows."

The tallest and most striking of our horsetails is the Great Water Horsetail, *Equisetum maximum.* It attains its greatest height when growing in muddy ditches, or in boggy places. The stems of this horsetail are of two kinds. The fertile stems, which appear about the month of April, are nearly 1 foot in height. They have large, loose, pale brown sheaths, with about thirty long slender teeth, and are surmounted by the large cones, often 3 inches in length. In colour they are reddish-white. The smooth barren stems, 4 feet or so in height, bear numerous whorls of branches, the latter being often again branched. Each whorl contains as many as thirty or forty branches. Towards the top of the main stem the whorls are close, but towards the middle they are more remote. The short sheaths, which have long slender teeth, fit the stem more or less closely. The slender branches, which, unlike the stems, are rough to the touch, are four angled. Each tooth of the sheaths found on the branches has two well-marked toothed ribs. This feature is worth noting, as it proves very helpful to us when identifying specimens which are less well developed than the normal forms.

Occasionally a third type of stem is found. It bears cones like those of the fertile stems, but much smaller, and branches like those of the barren ones, but much shorter, and less spreading.

The specific name, *maximum*, meaning "greatest,"

Barren Stem and Two Fertile Stems of Wood Horsetail

evidently points to the height of this species when compared with the other horsetails.

The Wood Horsetail, *Equisetum sylvaticum*, which is a shade-loving species, preferring woods, copses, and shady hedgebanks, is the most beautiful of all the horsetails. It is seen at its best only where it grows in colonies. The graceful whorled branches, drooping all round the upright stems, give the colony the appearance of a wood or forest in miniature. There are two stems almost smooth, and marked by about twelve furrows. The fertile stems when young are unbranched, but when the cone has disappeared, whorls of branches are produced. In both fertile and barren stems the branches which give off whorls of smaller branches at each of their joints are pendent, or drooping. The stem sheaths are loose, ending in three or four blunt teeth, while the sheaths of the branches bear only three long sharp teeth. Both stems, which are much alike, appear very nearly at the same time. No further description of this plant is required, as it can be easily identified by the drooping whorls of the compound branches.

Sylvaticum is derived from the Latin *silva*, "a wood," and is applied to this plant because its chief home is the woods.

The Marsh Horsetail is an exceedingly common species throughout the kingdom. It frequents marshes, ditches, and places only partially drained. The barren and fertile stems of this horsetail resemble each other

closely not only in height but in their whorled branches. The latter, of course, are topped by the short, blunt cones with dark coloured scales. Both are rough on the surface, and show from six to twelve rather prominent ridges, with the intervening furrows deeper than in most other species. The stem sheaths have fine pale teeth, with brownish or blackish tips and thin margins. The branches of the various whorls, which are equal in number to the furrows on the stem, are simple, and all have a tendency to turn upwards. Sometimes cones may appear at the extremities of the branches.

Palustre, the specific name meaning "belonging to the marshes," points to the places where this horsetail grows.

The Smooth Naked Horsetail, *Equisetum limosum*, may justly claim recognition from us on the ground of beauty alone. The almost perfectly smooth stems are faintly marked by from ten to thirty very slight ridges appearing to the eye only as faint lines. To this delicate marking against the light green of the stems the plant owes its attractiveness. Both barren and fertile stems are much alike, the only distinction being that the latter bear the short, blunt, oblong cones with black scales. As a general rule the stems are naked, but occasionally they show a tendency to bear whorls of branches. These branches when present are very imperfect. The stem sheaths, with their short, stiff, and distinct teeth, are short and pressed close to the stem.

The Variegated Horsetail

Shallow ponds, ditches, and the edges of lakes are frequently overrun by this horsetail, which often reaches a height of 3 or 4 feet.

Limosum, a Latin word meaning "full of mud," refers to the nature of the soil in which this plant is generally rooted.

The Variegated Rough Horsetail, *Equisetum variegatum*, grows generally on the seashore, where its much branched rootstock and numerous fibrous roots help to keep the shifting sand in its place. But it may also be found on the banks of rivers and lakes. The barren and the fertile stems, which are frequently nearly prostrate, are seldom more than 1 foot high and are more often much less. Towards the top they are naked, the whorls of branches being confined to the base. As the popular name suggests, they are very rough to the touch. The ridges and furrows which are very distinct vary in number from four to ten. It is to the distinctive colouring of the sheaths, however, that we turn for an explanation of the adjectives, *variegatum* and variegated, appearing in the scientific and common names, respectively. The short, distantly placed, and close-clinging sheaths are pale green below and black above; hence the appropriateness of the above terms when applied to this horsetail.

Our list of horsetails is completed with the species of most importance from the standpoint of utility. This is the Rough Horsetail, better known by the name

of Dutch Rush. It grows very abundantly on the canal embankments and sea-dykes in Holland, where its vigorous underground root system proves invaluable in binding together the loose soil. As already pointed out, this is the species most largely employed as a polishing medium. In Britain it is not too well distributed and may be regarded as rather rare. The barren and the fertile stems are both tall and much alike in appearance. The great abundance of flinty particles the stems contain renders the plant exceedingly rough to the touch. It is this roughness which makes it so valuable from the commercial point of view. The sheaths, too, are very distinctive. They are whitish, with black bases and margins.

Like *Equisetum limosum*, this horsetail has naked stems, which are rarely, if ever, branched. When branches do occur, they are confined to the base. The botanical name of this species is *Equisetum hyemale*. *Hyemale* is a Latin adjective signifying "pertaining to winter," an allusion to this plant persisting during that season.

The chief points in this chapter, apart from the descriptions of individual plants, are as follows :

1. Horsetails are classed as fern allies, because, like ferns, they are reproduced from spores with the intervention of a prothallium existence.

2. While there is no differentiation in the spores of horsetails, they nevertheless give rise to prothallia of two kinds, male and female. To the spores are

attached four bands, very sensitive to changes in the humidity of the air.

3. The spore capsules are fixed to hexagonal scales arranged in clusters round the head of the stem.

4. Horsetails have both barren and fertile stems, in some cases very unlike, in others very similar.

In concluding this little book we add a word of warning. The descriptions of plants herein given, be it noted, refer only to fully grown specimens. It is a common failing of young enthusiasts to pick up immature plants, especially fern fronds, in the expectation that they will be able to identify them from the book descriptions. Of course, it is possible to do so in some cases, where particular plants have some very distinctive feature peculiar to themselves alone, but in the majority of cases such practices lead only to failure and disappointment. There is no class of plants so difficult to identify in the young state as the fern group; therefore the beginner should always seek out at first only fully mature specimens. Having done so, he can then turn with confidence to the book for guidance as to names, etc.

With this note of warning we conclude this Peep at Nature, with the hope that it will remove some of the difficulties which beset the path of the young botanist who goes forth to learn something of the wild ferns, clubmosses, and horsetails of his native land.

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