

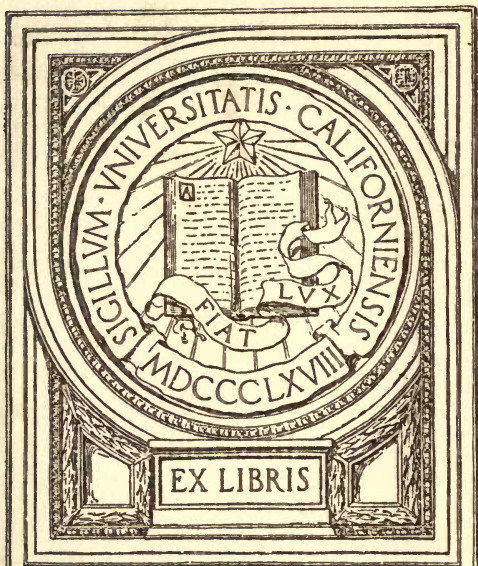
HOW TO KNOW THE FERNS

S. LEONARD BASTIN

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BY

S. LEONARD BASTIN

WITH THIRTY-THREE ILLUSTRATIONS

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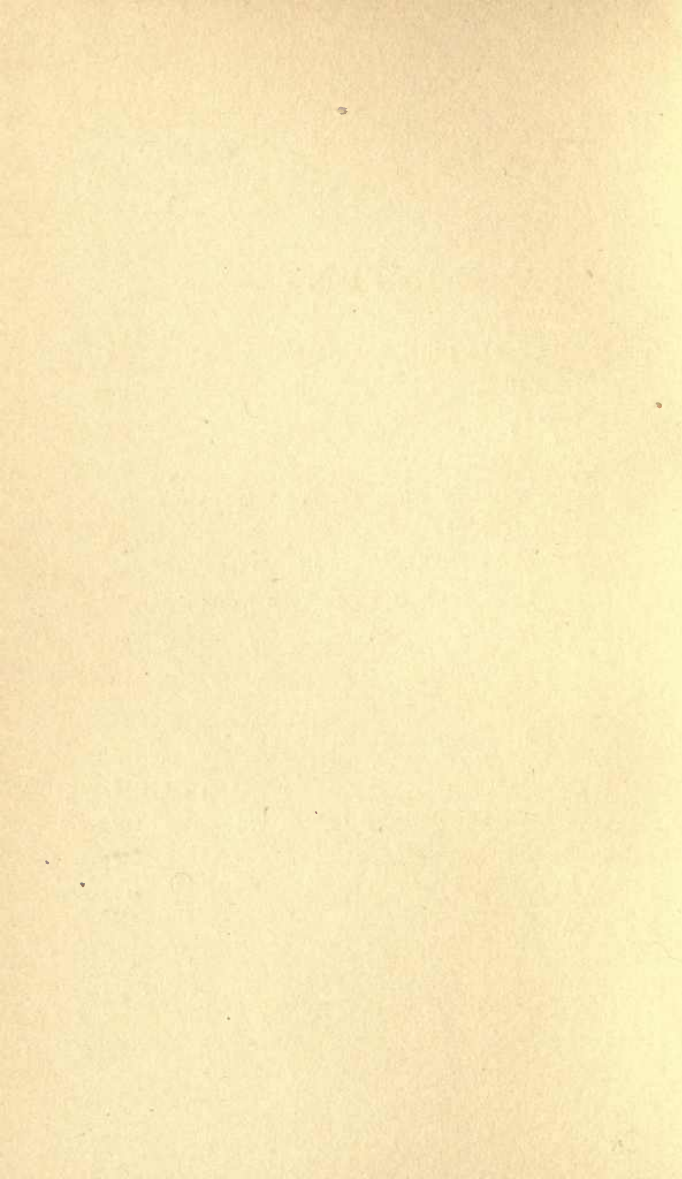
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HOW TO KNOW THE FERNS

CHAPTER I

THE FERNS AND THEIR ALLIES

IN its lowest forms vegetable life is a very simple affair. The minute Algæ which clothe damp surfaces with a green film show few indeed of the characteristics with which we are familiar in the higher plants. Certainly they are green, proving that the tiny cells of which they are composed contain the wonderful colouring matter—chlorophyll, by means of which they are able to assimilate carbon from the carbonic acid of the air. There is, however, in these lowly plants no sign of a stem, a leaf, or a root. As we ascend in the scale of vegetable life we begin to get an increasing number of distinctive characters. In the case of the Mosses we have plants with distinct stems and leaves. But Mosses have no true roots, neither is there any vascular (woody) tissue in their composition. Mounting yet higher in the scale we come to a very important and interesting group of plants usually referred to as the Vascular Cryptogams. In this group are included the Ferns, the Horsetails, and the Club Mosses.

In passing, it may be pointed out that the term *Cryptogam* is a name which was originally given to the flowerless plants by Linnæus to indicate that the plan of fertilization was hidden. The name is still retained, but it has lost its meaning in this sense, in that since the introduction of high-power microscopes it is not necessarily more difficult to study the fertilization of the non-flowering plants than it is to watch the process in the kinds which bear blossoms.

A small acquaintance with the Vascular Cryptogams will show us that they approach very closely to the flowering plants, or *Phanerogams*, as they are called, in their general features. It is true that in the cases of the Club Mosses and Horsetails the leaves are small or very poorly developed, but with the Ferns the foliage is often of an advanced type. All the Vascular Cryptogams, apart from a few insignificant exceptions, produce real roots; and, as the name implies, in a botanical sense, evidence woody tissue in their composition. Whilst the Club Mosses and Horsetails are comparatively humble plants, the Ferns have reached a remarkable development in the arboreal species. These, of course, grow into large trees which may be fifty or more feet in height, with thick woody trunks. Our common Male Fern not infrequently forms a short trunk-like stem if it is allowed to remain in an undisturbed state for a number of years. Not all the Ferns are large or even of moderate size; many of the Filmy Ferns are so minute that they are often taken for Mosses by those who do not know any better.

All the Vascular Cryptogams show an alternation of generation; that is, in the life history of each plant there is a sexual and an asexual individual. As is fully explained later, the

plant which arises from the spore of the Vascular Cryptogam is quite an insignificant body known as the prothallus. This has a comparatively short existence in most cases. It is on the prothallus, however, that the sexual organs are produced, and after fertilization the plant as we know it arises. This individual is called the sporophyte. The plant is responsible for the spores which are produced in little cases called sporangia. These are borne straight on the leaves, and are produced without anything in the way of fertilization having taken place. As far as the Ferns are concerned, the spores are all of one kind, but in certain of the Club Mosses two kinds of spores are produced.

Apart from a few exceptions the Vascular Cryptogams are mostly perennial in habit. In many cases other means of reproduction are available than the agency of spores. It is believed that the Bracken Fern is rarely reproduced by its spores. The increase of this plant seems to be very effectively carried out by means of the strong growing underground stems which shoot about in all directions. The Horsetails commonly propagate themselves in the same way, and it is this which makes them so difficult to eradicate in the garden. In the case of many Ferns a common mode of increase is that of budding off new plants on the leaf. The well-known New Zealand species, *Asplenium bulbiferum*, produces little buds on its fronds; these grow into small plants, so that each leaf may be responsible for dozens of new individuals. An even more singular case is the so-called Walking Fern from North America (*Scolopendrium rhizophyllum*), which bears long, tapering leaves something like our Hartstongue. These bend over in such a way that their tips

HOW TO KNOW THE FERNS

touch the ground; on the point of the frond a bud is developed. Roots go down into the soil from the point of the frond, leaves shoot upwards, and thus a new plant is born. In some species of Club Moss the increase of the plant by spore production is supplemented by a plan which involves the bearing of bulbils on the shoots. These are vegetative processes which give rise to new individuals when they tumble to the ground.

It is of interest to consider the general characteristics of the members of the Fern tribe. As a rule the stem is either in the nature of a short underground process bearing a rosette of leaves, as in the case of the Male Fern and Hartstongue, or there is a horizontal stem more or less below the surface of the soil, such as is to be seen in the case of the Bracken Fern and the Polypody. Sometimes the stem assumes the proportions of a trunk, but these Tree Ferns only occur in the tropics. Where the stem of the Fern is upright it is properly termed a caudex, whilst in its horizontal form it is spoken of as a rhizome. There is actually some doubt as to the real nature of the frond of the Fern. Some botanists are inclined to believe that it is not really a leaf at all, but is a modified stem structure. Those who hold this view consider that the curious scaly structures so common amongst Ferns are really the leaves of the plant. Here the matter must be left on the present occasion, as it is proposed to use the terms leaf and frond as meaning the same thing.

An outstanding feature in the case of most Ferns is the remarkable manner in which the fronds are subdivided. In the case of the Male Fern it is seen that the upper part of the stalk, or rachis, as it is called, bears two rows

of leaflets. These leaflets are properly referred to as pinnæ. When the leaflets are subdivided the divisions are spoken of as pinnules. These pinnules may be deeply lobed, and when this is the case each lobe is called a segment. In very large fronds the pinnules are again divided; the frond is then said to be tri-pinnate. Sometimes towards the top of the pinnæ or the frond the divisions become less pronounced; this character is designated pinnatifid. It should be noticed that the lower portion of the stalk, on which there are no pinnæ, is called a stipes. Of course in some cases, as with the Hartstongue, the leaf is quite undivided, without even any very pronounced indentations on the margin.

The unrolling of the Fern frond is a very beautiful process. Where the leaf is not divided in any way the process of expanding resembles the uncoiling of a watch-spring. Even where there are divisions the unrolling goes forward in the same manner with each subdivision, even down to the lobes. This particular mode of unfolding is called circinate. The texture of the leaves of Ferns is mostly thin and delicate, so that apart from some exceptions the foliage is not able to withstand the action of dry air. A notable feature with a large number of Ferns is the length of time which the leaves take to develop. The fronds of the Male Fern, for instance, start in the bud at least two years before they actually unfold. An examination will show that the roots of the Male Fern spring from the frond bases. It will be found that the position of the roots is the same in all Ferns.

With all Ferns the production of spores is confined to the leaves. In many instances there is no distinction between the fertile and the

barren leaves. The stem does not start at once to produce leaves bearing the sporangia or spore cases. Thus, in the very young Fern the fronds are always barren; as the stem becomes older, fertile fronds are produced. In some cases the sporangia are borne on distinct leaves, as in the case of the Hard Fern, or on special parts of the leaves, in the manner to be seen in the Royal Fern. The difference in such cases is not really a very important distinction. A careful examination of the fertile portion of a Royal Fern frond will show a small amount of green tissue, or mesophyll, as it is called, at the lower portion of the pinnæ. Actually the fertile leaf, or part of a leaf, is similar to the barren portions, save that it produces a much reduced amount of green tissue or, in some cases, perhaps none at all.

In general appearance the Club Mosses bear a resemblance to the true Mosses, and hence the popular name, which is certainly rather misleading. With these plants the leaves are small and almost bristle-like, and are gathered closely round the stem. In many of the Club Mosses a large part of the stem lies closely along the ground, and from this at intervals roots are sent down into the soil and leafy shoots rise upwards. The sporangia are produced on special leaves, which are usually gathered together in the form of cones.

Although they vary somewhat in size, all the Horsetails are striking plants. Here there is a branching underground rhizome from which arise the aerial stems. The most distinctive feature of the plant are the whorls of smaller branches which arise from the joints of the main stem. These carry on the work which is usually assigned to the foliage of the average

plant,—that is, the assimilating of carbon from the carbonic acid of the atmosphere. The real leaves of the Horsetail are much reduced in size, and take very little part in the work of nutrition. We shall find them at the joints of the stem as rings, each collection forming a kind of sheath. The leaves, which are usually of the same number as the branches, show no sign of their individuality, save in the little projecting teeth. In some species the fertile shoots, which appear in the form of cones, are produced specially. These appear in the spring before the ordinary vegetative growths, and are quite destitute of chlorophyll. In other species the normal green shoots are fertile at the termination. The sporangia are borne on curious scale-like leaves, a large number of which go to the making of a cone.

One or two aquatic plants, which belong to the Vascular Cryptogams, call for comment. The Pillwort is a singular plant not uncommon in damp situations. The leaves of this plant are narrow, and the spores are produced in curious rounded processes. The Water Fern (*Azolla*) is an introduced plant which sometimes grows abundantly on lakes in the South of England. Both the before-mentioned plants are allied to the Ferns. The Water Club Mosses (*Isoetes*) are represented in this country by a species commonly known as the Quillwort. This plant grows in lakes, and is easily recognized by its quill-like foliage.

Owing to the large number of species a somewhat elaborate classification is necessary in the case of Ferns. In distinguishing the different families, the manner in which the collections of spore cases, known as sori, occur, as well as the features which the individual sporangia present,

are important guides. The actual position of the sorus on the leaf, the presence or absence of a covering (indusium), are also distinctive features, both in the families and sub-families. When the individual sporangium is examined it is found that there is often present an annulus, a special ring of cells which plays an important part in the rupturing of the case. The extent of this ring or (as sometimes happens) its absence will alike be a decisive factor in fixing the family to which a species belongs. In some families a prominent feature is the fact that the sporangium has little or no stalk, although this is the exception rather than the rule. For a more complete description of the sporangium of the Fern the reader is referred to a succeeding chapter. It is certainly helpful to a study of these beautiful plants to try to fix in the mind the families, and their characters, of the order *Filices*. In all there are eight families belonging to the Fern tribe. These are given in the order in which they occur in technical books.

1. *Hymenophyllaceæ*.—The Filmy and Bristle Ferns. This family includes some of the simplest kinds of Ferns. There are only three representatives in the United Kingdom. These are *Hymenophyllum tunbridgense*, *H. Wilsoni*, and *Trichomanes radicans*. The two former species are fairly common on rocks which are splashed with water, but the latter seems only to occur in restricted districts in the South of Ireland. All the species must have an abundance of water, or the foliage quickly shrivels. This is due to the fact that the leaves consist of a single layer of cells and are, of course, very thin. A distinctive feature in this family is the bearing of the sporangia; these are almost or

entirely stalkless. The sorus, as the group of sporangia is called, is surrounded by an enclosure from the leaf margin. In *Trichomanes* this is cup-shaped, whilst in *Hymenophyllum* it is bivalved. The popular name Filmly Fern—bestowed on the *Hymenophyllums* and allied species—has reference to the semi-transparent nature of the fronds. In the case of *Trichomanes* the axis on which the sporangia are inserted often projects beyond the cup in which they are contained. This gives a curious spiky appearance to the fertile frond, and hence the name Bristle Fern.

2. *Polypodiaceæ*.—This is a very large family, containing two or three times as many species as all the rest of the Vascular Cryptogams put together. Nearly all our native species, with a few exceptions, belong to the family. A distinctive feature is the incomplete annulus of the sporangium. Another point to notice is that the spore cases are stalked. So large is the family that it has been divided into a number of sub-families; the members of these are chiefly characterized by the position of the sorus, the cluster of sporangia on the back of the frond. The different sub-families may be briefly outlined.

(a) *Davalliaceæ*.—There are no British representatives of this family. In this case the sorus is always near to the margin of the leaf, and the indusium or covering is cup-shaped. A familiar species is *Davallia bullata* from the East; the rhizomes of this Fern are trained into various shapes by the Japanese.

(b) *Pterideæ*.—The Bracken Fern (*Pteris aquilina*), the Maiden Hair (*Adiantum capillus-veneris*), and the Parsley Fern (*Cryptogramme crispus*) belong to this sub-family. A notable

feature of the Bracken is the continuous marginal sorus. There is no proper indusium, but the leaf margin curls over and protects the sporangia to some extent.

(c) *Aspidiæ*.—The sorus is in the form of a little rounded heap. The indusium, which is usually kidney-shaped, is supported by a central stalk, somewhat after the manner of a nasturtium leaf. The Male Fern (*Nephrodium filix-mas*) belongs to this sub-family, as well as the Bladder Ferns (*Cystopteris*) and the *Woodsias*.

(d) *Aspleniæ*.—Here the sorus is elongated or linear. The indusium arises from a vein to which the sorus is attached. Some very charming Ferns belong to this sub-family. Many botanists include the Lady Fern (*Athyrium filix-fœmina*) in this section. Certain of the Spleenworts (*Asplenium*) are common. The Wall Rue (*A. ruta-muraria*) and the Black Maidenhair Spleenwort (*A. adiantum-nigrum*) are well known.

(e) *Polypodieæ*.—The sori on the underside of the leaves are without any indusium. They are in rounded clusters, and look like small buttons. *Polypodium vulgare* is one of our commonest Ferns. Some of the other species of this genus, such as the Oak Fern (*P. dryopteris*) and the Beech Fern (*P. phegopteris*), are abundant in some localities.

(f) *Grammitideæ*.—The Gold and Silver Ferns. The only British species is the Annual Maidenhair (*Gymnogramma leptophylla*). The plant occurs in the Channel Islands. This species is one of the few Ferns which are not perennial. The sori, which follow the veins, have no indusium.

(g) *Acrosticheæ*.—There are no British representatives of this sub-family. In this case the

whole of the underside of the leaf is covered with sporangia, and there is no indusium.

3. *Cyatheaceæ*.—There are no British representatives of this family, which is interesting, owing to the fact that it includes the Tree Ferns.

4. *Gleicheniaceæ*.—A group of Ferns which are almost entirely tropical.

5. *Schizæaceæ*.—Another tropical family.

6. *Marattiaceæ*.—A family of large and handsome Ferns, the members of which occur in the tropics. There are not many representatives of this family nowadays, but remains in the Coal Measures show that the species were very much more numerous in Palæozoic times.

7. *Osmundaceæ*.—A small family, but rather an important one, owing to the fact that a leading representative, the Royal Fern (*Osmunda regalis*), is so well known. In this species only the upper portion of the leaf is fertile. The sporangia have very short stalks, and are not provided with an annulus, at all. They burst open in a longitudinal slit, opposite to a special group of cells just below the apex. The sorus has no indusium.

8. *Ophioglosseæ*.—This family is represented by three British species, of which the Moonwort (*Botrychium lunaria*) and the Adder's Tongue (*Ophioglossum vulgatum*) are best known. There is much doubt as to whether this family can be properly included amongst the Ferns at all. We may here give them the benefit of the doubt. The leaves in these species are unfolded from the sides—a totally distinct plan from that to be observed in all the Ferns which have been described, where the frond and its divisions are unrolled upwards. The prothallus is a small underground body destitute of chlorophyll. The fertile leaves are distinguished from the

barren ones by the production of a special branch which bears the fructification. The sporangia are large.

The next order of the Vascular Cryptogams is of comparatively small importance as far as the present study is concerned. It is known as the *Rhizocarpeæ* (Pepperworts). The order is divided into two families as follows:—

1. *Salviniaceæ*.—The only two genera are *Salvinia* and *Azolla*; the latter has been already mentioned.

2. *Marsiliaceæ*.—The British example is the Pillwort (*Pilularia globulifera*).

The Club Mosses have been divided into six families. Two of these—the *Lepidodendraceæ* and the *Sigillariaceæ*—are only represented by fossils; and one, *Psilotaceæ*, has no British representatives. The remaining families all include one or more species which are indigenous to our islands.

1. *Lycopodiaceæ*.—These are the Club Mosses proper. Several species of the genus *Lycopodium* are British. The Common Club Moss (*Lycopodium clavatum*) is often abundant on high moors.

2. *Selaginellaceæ*.—A large family containing three or four hundred species, only one of which, however, is British; this is *Selaginella spinosa*.

3. *Isoëtaceæ*.—A family of aquatic Club Mosses. The British species is *Isoëtes lacustris*, a plant which is sometimes common in the northern lakes.

With this brief survey of the Vascular Cryptogams one may naturally pass to a somewhat more detailed consideration of the life histories of these interesting plants than it has been possible to give in an opening chapter.

CHAPTER II

LIFE HISTORIES

EVEN the most general survey of the Vascular Cryptogams would not be complete without an attempt to indicate the means of reproduction to be observed in these plants. The subject is one which might well be treated at great length, for there is scarcely any species which does not present some interesting point that calls for comment. Within the limits of the present inquiry it will not be possible to give more than an outline of the reproductive schemes to be observed in a few typical species. These life histories must not be taken as necessarily applying to all the related plants. None the less, by a careful study of the species described we may receive a fair conception of the habits of the class to which it belongs. Incidentally it may be mentioned that even a low-power microscope will be an enormous help in studying the life histories of the Vascular Cryptogams ; but if this is not possible, a pocket-lens will help to a better understanding of many of the points described.

For the study of the life history of a Fern one cannot do better than take the commonest of our native species, the Male Fern (*Nephrodium filix-mas*). Seeing that the general aspects of the plant are fully described in a later chapter,

there is no need to enter into such matters at the present moment. We may, however, examine a fertile leaf of the Fern in order that we may start at the beginning of a really interesting romance. A very small magnification of the brown patches on the back of the frond, which we remember are called sori, will reveal their true character. After removing the kidney-shaped cover (indusium) we shall be able to see the spore cases or sporangia quite clearly. Each of these consists of a capsule borne on the end of a stalk. These sporangia are seen to grow out from the sides of a mass of special tissue, known as the placenta, from which the indusium really arises. On occasions a curious club-shaped hair which secretes resin can be observed on the stalks of the sporangia. There seems to be no satisfactory explanation as to the part which this process plays. The capsule of the sporangium is much flattened, and has not been inaptly compared to a watch-case. Its wall is very thin, being composed of a single layer of cells. Around the edges of the little case there is a row of large and thickened cells which form the ring or annulus. Here it may be mentioned again that the structure of this annulus varies greatly in the different families, and is often a useful distinguishing feature. To return to our Male Fern, the annulus is plainly seen to start from the stalk of the sporangium at one side of the capsule, and it can be traced right over the top to a situation about half-way down on the other side. The chief business of the annulus is to bring about the opening of the sporangium in such a way that the spores are violently expelled. This happens in the following

manner. When the contents of the sporangium are mature the wall of the capsule, and especially the cells forming the annulus, begin to lose water. The sides of the capsule start to draw inwards, and ultimately the annulus suddenly straightens out and the sporangium is torn open, the actual rupture taking place just at the base of the ring.

The manner in which the spores originate in the sporangium calls for comment. In the case of the Male Fern these arise owing to the repeated division of a single cell. At a certain stage in the process there are produced what are known as mother cells. Ultimately these divide twice, and the resulting cells represent the spores. When ripe, the spores become kidney-shaped and the wall of the cell takes on a rich brown colour. In the different kinds of Ferns, the form of the spore and the sculpturing of its walls vary a great deal. Thus the spores may be globular, oval, or angular in shape; whilst the exterior may be quite plain, or, perhaps, most beautifully marked. The number of spores produced in the sporangium of a Male Fern is usually some forty-eight to sixty-four, although in other species there might be less than the lower figure or more than the higher. To the naked eye the spores appear to be so much dust, and as they are comparatively light they float away on the breezes, and often enough travel for a considerable distance before coming to rest. As a rule the bursting of the sporangia takes place during dry weather. There is a real advantage in this, for when the spores are damp they hang together in masses and in such a state a wide dispersal would be out of the question.

The best thing that can happen to the spore is that it should settle upon some moist soil. Here it may be mentioned a most instructive experiment is the sowing of a few fern spores. This may be carried out in ordinary garden soil, although it is wise to sterilize it before use. All soil contains the germs of such organisms as mould which, in cultivation at any rate, is especially destructive to developing spores. The plan is to bake the mould in an oven until it is so hot that one cannot bear to touch it. We shall get any number of spores from the fertile leaf of a Male Fern by just tapping the frond whilst holding it over the surface of the soil. Do not scatter the spores too thickly, or it will be difficult to examine the stages of development, and remember also that the soil should be moist at the start. The results of this spore culture are always more satisfactory if the soil is covered with a bell-glass—an ordinary tumbler would do if nothing better is available. Water must be given as necessary, though do not swamp the soil; the best plan is to let the liquid in a few drops at a time.

In the case of the Male Fern the germination of the spore will start in about eight days, but in other species the period varies. Many of the succeeding stages cannot be intelligently followed except with the aid of a microscope. The first thing which happens to the germinating spore is the development of a root hair which helps in fixing the process to the soil. A system of cell division now commences in the other portion of the spore which results in the formation of a green filament, every cell of which is capable of producing root hairs. This filament is the beginning of the body,

known as the prothallus, which is responsible for the sex organs. The process of cell-division goes forward and ultimately results in the development of a green scale measuring, perhaps, an eighth of an inch across at its broadest part. This is the fully-grown prothallus. From the underside arise more root hairs, and it is here also that the antheridia (male organs) and the archegonia (female organs) are produced. As a rule, both kinds of organs occur on the same prothallus, although now and again prothalli have been discovered which are exclusively male or female. The matter is of interest, because it evidences an occasional distinction of sex which has become habitual in some of the Club Mosses. In the case of a perfectly normal prothallus the male organs or antheridia are to be found amongst the root hairs, whilst the female organs or archegonia arise from a cushion, several cells deep, more towards the centre of the process.

The manner of fertilization may be briefly outlined, although the observation of this is beyond the ordinary student. With Ferns, as is the case with nearly all the Cryptogams, the fertilization takes place under water; the moisture may be the outcome of heavy rain or even dew. However that may be, as soon as the underside of the prothallus has become thoroughly wetted the antheridia open, and certain little bodies called spermatozoids are allowed to escape. These are exceedingly active, and are in the form of spirally coiled bodies with a number of fine threads (cilia) at one end. The same moisture which caused the antheridia to open also brings about the opening of the archegonia. Some time ago it

was shown that the spermatozoids steered a decided course towards the archegonia, but the reason for this has only been comparatively recently explained. At the mouth of the archegonia there is a viscid drop which almost certainly contains chemical substances attractive to the spermatozoids. Although the nature of the substance is not exactly known, it is suggested that this may be malic acid, seeing that experiments have shown that the spermatozoids are attracted to this product when it is artificially introduced. Of course the matter is a difficult one to prove, in that the viscid drop is so minute that it is impossible to determine the nature of the substance which it contains. Malic acid has, however, been discovered to be present in the prothallus as a whole. Although there is quite a competition amongst the spermatozoids as to which shall enter the archegonium, it is likely that only one actually succeeds in entering the egg cell. As a rule, too, in the prothallus only one of the archegonia shows any further signs of development.

After the fertilization is completed the first happening is the formation of a cell-wall round the ovum. Passing through various stages of growth and subdivision it finally forms the embryo of the young plant. For a while the newly-born Fern relies upon the prothallus for sustenance, but eventually starts an independent existence. The baby sends down roots into the ground and leaves up into the air, and from thenceforward its development into a mature plant will only be a matter of time.

The life histories of the Club Mosses have certain points which make them of special interest. In the first place, the manner of

reproduction to be observed in the Lycopodiums may be outlined. Sometimes the sporangia are borne on fertile leaves which exactly resemble the ordinary ones; a good instance of this is seen in the case of the Fir Club Moss (*Lycopodium selago*). On the other hand, the fertile leaves may be gathered together into cones such as are to be observed in the case of the Common Club Moss (*L. clavatum*). The sporangium is quite a large affair, easily discerned with the naked eye. The number of spores produced is enormous—so much so that these can be shaken out in a thick powder. In some of the Lycopodiums the spores have a remarkable habit of resting before the development of the prothallus. It is said that in the case of the Common Club Moss the prothalli do not appear until the end of the sixth year. Even then, several more years elapse before the prothallus is sufficiently mature to bear the organs of sex. In the case of *L. inundatum* the length of time which elapses between the coming of the prothallus is nothing like so great. With all the Lycopodiums, however, the prothallus, which varies a good deal in the different species, bears both kinds of sexual organs. In most of the cases where the development of the spore is such a long business the prothallus is produced underground. With *L. inundatum*, however, the prothallus is green and leaf-like. The underground prothalli have no chlorophyll, and hence cannot live the life of an independent green plant. It has lately been demonstrated that these are always found in conjunction with a certain fungus; probably the benefits of the association are mutual. Making allowance for certain differences which are not of great im-

portance to the general student, the fertilization of the egg cell in the prothallus of the *Lycopodium* is carried out on very similar lines to those which have been described in the case of the Fern.

The life histories of the Selaginellas evidence some important differences which call for special comment. Here throughout the whole family the spore-bearing part of the plant is in the form of very definite cones. As in the case of *Lycopodium* there is only one sporangium to each leaf, but they are of two kinds. One, on account of the fact that it is responsible for the production of small spores, is called the microsporangium; the other, the megasporangium. The two kinds of sporangia are usually present on the same cone, although the microsporangia are as a rule higher up the stem than the megasporangia. The number of microspores produced is very large, but only four megaspores are borne in each megasporangium. The megaspores are, of course, very much larger than the microspores. The germination of the megaspores is started in the sporangium; at a certain point in their development they are shed. In the case of the microspores germination commences after the spores have fallen on to moist soil. The prothallus is exceedingly small, being little more than a group of cells forming an antheridium. Should there be sufficient moisture about, the spermatozoids which are produced by the antheridium swim towards the archegonia in any female prothallus which may be near. Fertilization then takes place, and the final outcome is the young plant. Now and again in certain species it is seen that the megaspores develop to such an extent within the sporangium that fertilization

takes place, and even an embryo or young plant may be formed.

There remains to be considered the life history of the Horsetails. The spores are always produced on special processes, which are arranged in the form of a cone at the apex of the stem. The sporangia are borne on curious scales which are supported by stalks placed in the centre. These scales are arranged in whorls round the centre of the stem, and there may be twenty or more in each row. On the underside of these scales we shall find the sporangia—almost any number of them up to ten. Each sporangium produces a considerable number of spores, so that every cone is responsible for an enormous number. These spores are all of one kind, and they are so singular that they are worth a somewhat detailed description. The covering of the spore really consists of four layers, the outermost of which is split spirally in such a way that two long arms with flattened ends are produced. As long as the spore is damp these remain closely gathered round, but under dry conditions they are stretched out. The movements of these arms or elaters, as they are called, are readily watched under a microscope. By gently breathing on the spores we bring them under the influence of moist air, and this causes the elaters to curl up; after a while, however, when they become dry, the arms stretch out again. It is not certainly known what is the use of these elaters. A very little observation shows that the opening and closing of the arms keeps the spores on the move; this would aid dispersal at the time of the bursting of the sporangium. Another point which is worth consideration is that although the spores appear to be exactly the same, yet

as a rule they develop on distinctive sex lines. It is obviously important that the male and the female prothallus should be together. The long arm-like processes on the spores often link the little bodies side by side, and this would be an advantage.

The spores of the Horsetails are not long in developing after they have settled in a damp situation. The actual forms which the prothalli take are often very irregular. That of the male prothallus is usually rather small ; on the other hand, the female prothallus is sometimes large, and may have complicated branchings. As in the case of the other Vascular Cryptogams which have been considered, spermatozoids are produced in the antheridia. These are very active, and travel through the agency of water to the archegonia on the female prothallus. The spermatozoids unite with the various egg cells, and in this way an embryo is formed which finally develops into the mature plant. Owing to the fact that the prothalli of the Horsetails have proved to be excessively difficult to cultivate, the life history has not been so completely worked out as in the case of the Ferns and Club Mosses. One interesting point in connection with the cultivation of Horsetail spores has been brought to light. Whenever the spores are growing on poor soil, by far the larger number of them produce antheridia. On the other hand, where there is plenty of nourishment the tendency is all the other way. The matter is of interest, as it appears to show that the amount of available nutriment is a definite factor in the determination of sex.

CHAPTER III

YESTERDAY AND TO-DAY

ALTHOUGH to most people the study of fossil botany may appear to be an uninviting pursuit, there can be no question as to the importance of the science. It is only in this way that we are able to appreciate the changes which have led up to the existing types of plants. Now the question of the past history of the Vascular Cryptogams is of very special interest in more ways than one. It is, of course, most fascinating to be able to discover what kinds of Ferns flourished, for instance, at the period when the coal deposits were being formed. But, even in a cursory description, it will be quite impossible to allow the matter to rest there. The story of the past, in the case of the Vascular Cryptogams, is closely interwoven with some of the most absorbing phases in the evolution of the Flowering Plants which are such a dominant feature on the earth at the present time.

Quite recently we have had to alter our views materially on the matter of the past history of the Ferns. Within the last few years it has been proved that a huge number of the fossil remains, belonging to the Palæozoic formation at any rate, are not Ferns at all. They belonged to a very distinct race of plants altogether, known

as Pteridosperms, even though they had a superficial resemblance to Ferns. After a large amount of patient research it has been demonstrated that these plants bore seeds. The method of flowering and seed-production was vastly different from that which is to be observed in the flowering plants of to-day. The male or pollen-bearing organs were produced straight on the foliage in much the same way as the sporangium of a true Fern is developed. In a similar manner the seeds were borne straight on to the leaf. In some general points these plants also bore a strong resemblance to the Ferns, and it was this which misled the early observers. Without a doubt these Pteridosperms were related to the Ferns, and probably at some remote period the two groups had a common ancestry. There is good reason for believing that at the same time these Pteridosperms were flourishing true Ferns were also well represented.

Now the interesting point about these Ferns is that they were not vastly different, in many ways, from the species which exist on the earth at the present time. Of course certain types, of which we have living examples, were more fully represented than is the case nowadays ; on the other hand, some of our most widely distributed families seem to have been at rather a low stage in their history. As well, the remains evidence a large number of very simple species, which perhaps give us an idea of what the original Ferns were like. But on the whole there is nothing to show that our living Ferns are any more developed than the highest types which grew in the coal forests. In these far-away times there were Tree Ferns ; but so there are, of course, at the present time.

The early botanists who strove to prove that Ferns were, so to speak, the last development before the Flowering Plants were not, perhaps, very far from the truth. It has been seen that during the period when the coal deposits were being formed there flourished side by side races of true Ferns and Fern-like plants which bore seeds—the Pteridosperms. The point has also been suggested that in all probability these two groups of plants had a common origin. With the coming of later times (the Cretaceous and Jurassic periods) there appeared the Bennettiteæ. These remarkable plants seem to have entirely taken the place of the Pteridosperms, and were an enormous advance towards the Flowering Plants of the present day. Only recently have the Bennettiteæ been properly described and their interesting features fully understood. We have a few representatives of this important group in the Cycads, plants bearing a superficial resemblance to Palms, but actually very different in all other ways. By the manner in which the reproductive organs are produced, and the way in which the scheme is carried out, these Bennettiteæ appear to be a half-way house between the cryptogams and the advanced flowering plants. The stamens bearing the pollen are produced on the fronds very much like the sporangia of Ferns. On the other hand, the seed-bearing structures are collected together into a sort of pistil. This was borne at the tip of the branches and ended their growth, just as happens in the case of Flowering Plants. For some reason which we cannot understand these Bennettiteæ seem to have fallen back in the race for supremacy, for the group is but poorly represented in our modern Cycads and a few allied plants. In all the world

there are perhaps not more than about a dozen species, the sole survivors of a race which at one time dominated the world. There seems every reason for thinking that the Flowering Plants arose as an offshoot of the Bennettiteæ, and in some way secured an advantage which enabled them to arrive at their present position.

When we come to consider the past history of the Club Mosses the record is of a different nature to that of the Ferns. Nowadays the Club Mosses are not of great importance in the world, even though, as will be shown later, the number of species is considerable. But when we travel back to Palæozoic times, particularly in the coal period, it is evident that these plants were represented by a number of very large and dominant families. Some of these early Club Mosses certainly came very near to rivalling the Flowering Plants. Probably the tendency of the world to become drier has had something to do with the decline, seeing that in all cases the fertilization is carried out under water. We may gather some idea of the importance of the Club Mosses in Palæozoic times from the fact that in every part of the world where coal deposits have been examined great numbers of the fossil remains of these plants are always discovered. Many of these grew into large trees which were a hundred or more feet in height, sending out great branching shoots above and an enormous root system below.

From a botanical point of view there is no doubt that some of the Club Mosses, particularly those belonging to the family *Selaginellaceæ*, have approached very nearly to the Flowering Plants. At the present time the existing species, the Selaginellas, bring us up to the very threshold of the dominant group. The lowest division

of the Flowering Plants is the *Gymnospermæ* (which includes the Conifers), and it is interesting to note the points of similarity between a typical Gymnosperm and a Selaginella. To start away with, the Selaginella bears two kinds of spores, each of which in its development has a definite sex character. The smaller ones (microspores) are in their manner of production analogous to the pollen-grains of the Flowering Plant. The prothallus and the male organ (antheridium) are comparable to the special cell-group in the pollen-grain, whilst the spermatozoids approximate to the generative cells. In the larger spores (megaspores) these represent the embryo sac, and the sporangium in which they are produced closely approximates to the part containing the embryo sac in the Flowering Plant. The prothallus which arises from the megaspore in the Selaginella closely resembles the endosperm—a special tissue formed to feed the embryo in the case of flowering plants. The female organ (archegonium) and the cell which it produces are practically identical in both cases. Fossil remains have shown that some of the plants like Selaginella which flourished in Palæozoic times seemed to have come very near to the production of seed. Thus one species which has been described shows a megaspore which was permanently within the sporangium, and which in its general development greatly resembled a fruit. It is, of course, impossible to give more than a very brief outline of some of the chief points in this highly important comparison between the Gymnosperm and the Selaginella. The author trusts that those of his readers who are interested will pursue the study in the admirable textbooks which are now available.

The Horsetails, like the Club Mosses, have had

a very important past. Although they are few in number, as far as the species are concerned, they still retain many striking characteristics. Without a doubt the Palæozoic Horsetails grew into giant plants, sending out branches and developing trunks which in some ways are comparable to those possessed by our trees at the present time. These great stems seem to have arisen from rhizomes which travelled about in the mud of the coal jungles. It is usual to refer to these Palæozoic Horsetails as Calamites, owing to the fact that they were originally supposed to bear a resemblance to a reed (*Calamus*). In the later rocks, such as those which belong to the Jurassic and Triassic periods, occur the Equisetites, plants which were still of great size, but already in some respects showing signs of that decline which has culminated at the present day in the little group of plants which, were it not for a certain robustness of growth, would find it hard to maintain their position at all.

To complete our brief survey of the Vascular Cryptogams it is now necessary that we should review the position of these plants at the present time. Of course in number the Ferns are enormously in advance of all the other plants put together. In the whole world, there are not far short of seventy distinct genera, which include anything between three and four thousand species. The Ferns of the United Kingdom number not far short of fifty, and there are certain variations from the type which some folk are tempted to include as species. For some reasons which we cannot well understand, the Ferns alone amongst the Vascular Cryptogams have been able to hold their own in the world. It is probable that

there are quite as many species, and that these are as varied, to-day as has ever been the case. The size of Ferns, as we have already seen, varies enormously. In the tropics and in Australasia there are Tree Ferns eighty feet in height, whilst with many of the Filmy Ferns the size is scarcely larger than that of Mosses. Owing to the fact that it is so necessary in the scheme of reproduction, the majority of Ferns are lovers of moisture. None the less, a few specimens have adapted themselves marvellously to drier conditions. Thus the Bracken will grow on the exposed hillside or cliff-top even where its rhizomes cannot carry the roots to a great amount of moisture. Some of the most interesting species of Ferns are those which grow on walls and rocks, where there is little dampness, during the summer at any rate. Many of these have adopted special devices to cope with drought, such as are to be seen in the Scaly Spleenwort. Here the underside of the frond is covered with hairy scales, and in dry weather the leaves roll up so that the well-protected underside is alone exposed to the sun. After all, however, Ferns are most at home where there is a comparatively deep shade with abundance of moisture. Many species which will grow in somewhat dry situations attain a much finer development under happier conditions.

Luckily many kinds of Ferns are still very common in the United Kingdom. Of course, in much-visited localities the ravages of the trippers have practically exterminated some interesting species in these particular districts. Naturally, one hardly expects to find the Royal Fern flourishing to any extent in the popular holiday haunts—none the less, there are still

any number of places where this noble plant "grows like a weed." The wise man does not talk about such things to his friends. Many of our most beautiful Ferns are saved even in much-frequented places on account of the fact that they grow out of reach. No doubt the graceful *Trichomanes* of South Ireland would long ago have been stamped out in the Killybegs district, were it not for the fact that it often grows in situations which it is almost impossible for anyone to reach.

As far as number is concerned, the living Club Mosses represent a comparatively insignificant group when compared with the Ferns. In all the world there are probably not more than five or six hundred species. These are very widely distributed, and there is hardly any part which cannot offer at least a few species. We have five species of *Lycopodium* in the United Kingdom. All are rather local, though often enough they occur in great abundance in special localities. Only one (*Lycopodium inundatum*) ever occurs in lowland districts; all the rest must be looked for on highland moors. A few exotic *Lycopodiums* grow to a fair size, though this is largely due to the fact that their creeping stems straggle along the ground for a considerable distance. The *Selaginellas* are a much more important group as far as the world generally is concerned. There are certainly as many as four or five hundred species, and some of these assume almost a shrubby habit. A species from Borneo (*S. grandis*) is said to attain the height of two feet. In the United Kingdom we have but a single species of *Selaginella*—*S. spinosa*, an insignificant little plant. Many exotic kinds are frequently grown in greenhouses, so that a

variety of species is within the reach of everybody.

Authorities vary as to the exact number of species which belong to the only genus of the Horsetail—*Equisetum*; the estimate is never higher than forty. Nearly all these plants are striking in appearance, and some are quite large. A tropical American species is said to attain the height of thirty feet, though this is not so remarkable when one considers that the plant has a climbing habit. In the United Kingdom we have at least eight distinct species. Some of these are exceedingly common, and owing to their vigorous growth will often hold their own against all comers. Indeed, the existing Horsetails are, to use a common expression, "putting up such a good fight" that it is certain they will continue to hold their own for many a long day. Unlike the Club Mosses, the Horsetails seem to be quite happy in the vicinity of towns, and are often seen at their best on railway embankments and in similar situations.

Although the Vascular Cryptogams played an important part in helping to build up our vast stores of coal, it is astonishing to note of what little direct economic value they are to mankind at the present time. In a few parts of the world, where the native races make little or no attempt at agriculture, the root-stocks of Ferns—often rich in starch—are eaten. Thus the Maoris of New Zealand and some of the South Sea Islanders secure a poor kind of sago from some of the Tree Ferns which grow in their districts. The Japanese use the growing tips of the Bracken as food. Years ago, Ferns used to be burnt for potash in this country, and their astringent properties naturally attracted the old-world pharmacist. They are practically

useless as fodder on account of their bitter taste, and no animal—except, perhaps, the goat—would think of eating Ferns. In many cases, however, Bracken is used regularly as a bedding-down material for cattle.

Coming to the Club Mosses, it is even more difficult to find that they are of any direct benefit. Some kinds in South America are said to yield a blue dye. Our Common Club Moss is in its huge quantity of spores responsible for the "Lycopodium Powder" which at one time was employed in the making of fireworks. The powder is said to be highly inflammable, but when shaken straight out of the cones it does not always ignite very readily. One of the Horsetails, the Dutch Rush (*Equisetum hyemale*), was—and perhaps is still—used in polishing, owing to the large amount of silica which is present in its stems. In addition, those who are interested in coast erosion say that the stronger-growing species of *Equisetum* should be planted to keep clay cliffs from falling. From an ornamental point of view the Ferns and some of the Club Mosses are, of course, of great value. They are widely cultivated in garden and greenhouse, and we may say that these plants make up in æsthetic value what they lack from an economic point of view.

CHAPTER IV

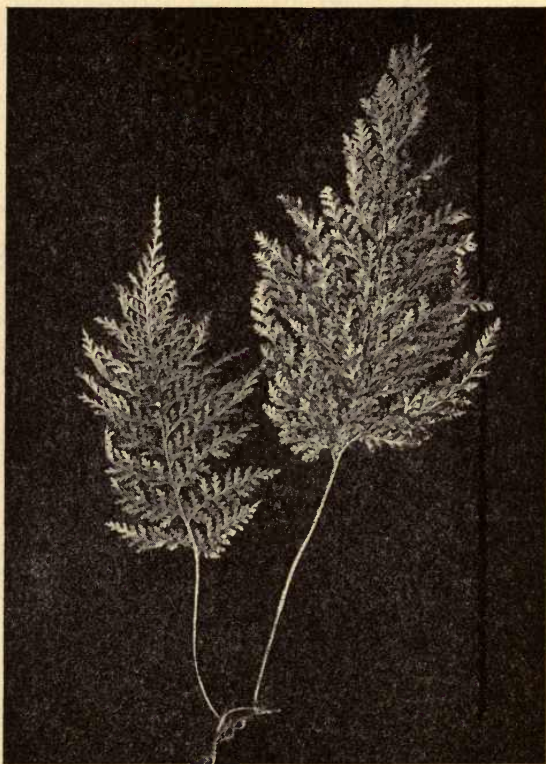
THREE DAINTY FERNS

ALTHOUGH the members of the family Hymenophyllaceæ are largely tropical, we are fortunate in having three representatives in the United Kingdom. Two of these, both Filmy Ferns, are not so familiar to people as they might be, if folk were only a little more observant; whilst the Bristle Fern is only to be found in the South of Ireland. All the species require an abundance of moisture, and they attain their greatest perfection on rocks which are dripping with water.

Trichomanes radicans. The generic name is said to be derived from two Greek words—*thrix*, “a hair,” and *manos*, “soft”; the specific name is obviously connected with the Latin *radix*, “a root,” and has reference to the creeping rhizome. The Bristle Fern.

This species is quite one of the most beautiful of our native species. Its fronds are very graceful in form, and are of such a delicate texture as to be almost transparent. The general outline of the fronds is triangular in shape. The leaves, varying in length from three inches to a foot, rise from a black, creeping rhizome, which will often cover a large area on a moist rock with a perfect network. The stipes or bare portion of the frond is, as a rule,

about the same length as the leafy portion. A singular feature is a wing-like margin which



Trichomanes radicans. The Bristle Fern.

is present on the upper part of the leaf-stalk. The frond of the Bristle Fern is divided three or four times, the first of the pinnæ being

placed alternately on either side of the rachis. The pinnules are deeply cut. The veins of the frond are very strongly marked. All the divisions of the leaf are more or less curled, so that the frond as a whole presents a curled appearance.

The sporangia of the Bristle Fern are borne of the veins in the lobes of the fronds. These are produced in curious cup-shaped processes which are really formed by the margin of the leaf. The veins pass right through these receptacles and project beyond the outer edges, thus giving a curious bristly appearance to the frond as a whole.

The Bristle Fern, as has been indicated, chiefly occurs in the South of Ireland. It has been discovered in several counties, though it seems to be best established in the Killarney district. Any attempt to cultivate this Fern will prove a failure, unless the plants are kept continuously under a close glass cover where the atmosphere is saturated with moisture. The Bristle Fern is evergreen.

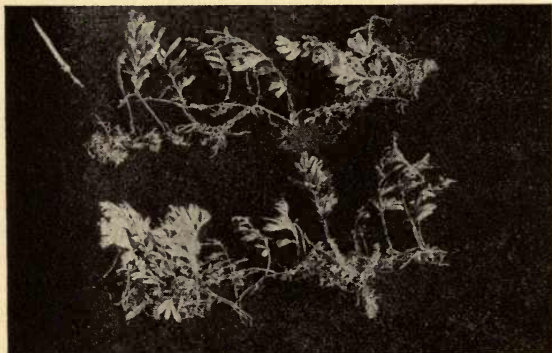
Hymenophyllum tunbridgense. The generic name is derived from two Greek words—*hymen*, "a membrane," and *phyllon*, "a leaf"; *tunbridgense* has reference to the fact that the species was first of all noticed at Tunbridge Wells. The Tunbridge Filmy Fern.

The fronds, rarely more than two or three inches long, are of a very dark green colour, and rise from a slender, creeping rhizome which produces immense quantities of fine roots. The texture of the fronds is of a delicate nature, and the veins are strongly marked; in colour the leaves are dark green. The outline of the fronds is roughly ovate; that is, it tends to be broadest towards the centre. The pinnæ branch alternately from either

side of the rachis, and these are usually very distinctly lobed. If examined with a magnifying glass it will be seen that the edges of the pinnules are bordered with bristling points.

In the case of the Tunbridge Filmy Fern, the sporangia are gathered in a little cup formed by the margin of the leaf; these are present at the end of the veins which branch out from the mid-veins of the pinnæ.

The Tunbridge Filmy Fern has a very wide



Hymenophyllum tunbridgense. The Tunbridge Filmy Fern.

distribution in this country. As a rule the plant grows intermingled with moss, and on this account it is often passed by without recognition. Almost everywhere where there are wet and especially water-splashed rocks one may expect to find this species. The Tunbridge Fern can only be cultivated in the same manner as that indicated in the case of *Trichomanes*. The plant is evergreen.

Hymenophyllum unilaterale. The specific name is, of course, a Latin word meaning

“one-sided”; the application of the term is explained in the following description. (In some books this species has been called *H. Wilsoni*, out of compliment to a Mr. Wilson, who is said to have noticed the species first of all.) The One-Sided Filmy Fern.

Some botanists have considered that the One-Sided Filmy Fern is merely a variety of the former species, though it is generally considered to be a distinct type. The two plants often grow mixed up together and superficially look very much alike; it is only after a close examination that the differences become apparent. In a general way it will be found that in the case of the One-Sided Filmy Fern the fronds are somewhat more narrow than those of the Tunbridge Filmy Fern. The chief point of distinction is indicated in the popular name:—if the pinnæ are closely examined it will be seen that the upper portion is much more divided than the lower side. Another distinctive point to which attention should be drawn is that in this species the pinnæ show a marked tendency to curve backwards.

A study of the fertile leaf of the One-Sided Filmy Fern will also give us an additional point in the identification. With a magnifying glass it is plainly seen that the margin of the cup-shaped receptacle into which the sporangia are gathered has not the toothed border to be found in the case of the Tunbridge Filmy Fern.

As has been indicated, we may look for the One-Sided Filmy Fern in exactly similar situations to those which suit the Tunbridge Filmy Fern. The former species is said to be more common in Scotland and Ireland than the latter. The One-Sided Filmy Fern is, of course, an evergreen.

CHAPTER V

THE BRACKEN FERN AND TWO INTERESTING SPECIES

MANY members of the Fern tribe are of a retiring disposition, and to find them we must search in out-of-the-way corners. This cannot be said, however, of the leading subject under discussion in this chapter, for of all native ferns there is certainly none with a wider distribution than the Bracken. As one of the few ferns not needing a moist situation, the Bracken is able to make itself at home almost anywhere, save perhaps in the vicinity of large manufacturing towns. The sub-family Pterideæ to which the Bracken belongs has not a large number of representatives in the United Kingdom. In the Ribbon Ferns and the Maidenhairs of our greenhouses we have evidence that, as far as the world at large is concerned, the Pterideæ are very numerous.

Pteris aquilina. The generic name is derived from the Greek word *pteron*, "a wing," and the specific name comes from the Latin *aquila*, "an eagle." The Bracken Fern.

The height and general outline of the Bracken Fern varies enormously. On exposed hillsides the plant may be barely a foot in height, with leaves correspondingly small. In the sheltered wood it is not an uncommon thing to discover

specimens which may be taller than a man. In such cases the fronds may measure as



Pteris aquilina. The Bracken Fern.

much as four feet at their widest parts. The fronds of the Bracken start to develop—in the South of England at any rate—about April and

are fully expanded by Midsummer. During September they turn a beautiful golden brown and finally die altogether, although the leaves do not decay quickly. The Bracken is, of course, a very strong-growing perennial, and the plant has a wonderful system of underground rhizomes. In a strong-growing specimen these rhizomes may be as thick as a finger and are very succulent. They are of a jet-black colour, and at the base of each frond there are sent out a quantity of fibrous roots. The fronds arise from either side of the rhizome, and often not more than one or two are developed in a single season. By examining the rhizome it is possible to discover the buds containing the new fronds for two years ahead.

The fronds of the Bracken Fern are roughly triangular in outline. That portion of the stipes which is under ground is of a dark brown colour, but the portion above the surface is of a bright green tint. The rachis, or foliage-bearing portion of the stalk, represents about half of the whole. On either side of the rachis the pinnæ are arranged in pairs, which are placed nearly but not quite opposite to one another. These pinnæ are divided again, and in very large examples there may be a further subdivision. In all the parts of the frond of the Bracken there is a tendency for less division at the apices of the different portions. It should be noted that the lowest pairs of pinnules, those next to the rachis, are often much modified; they are always small, and in some cases the upper pinnules are missing.

It is along the margins of the lobes of the leaf that the sporangia are produced. There is no proper indusium, the spore cases being protected by the rolling back of the margin of the

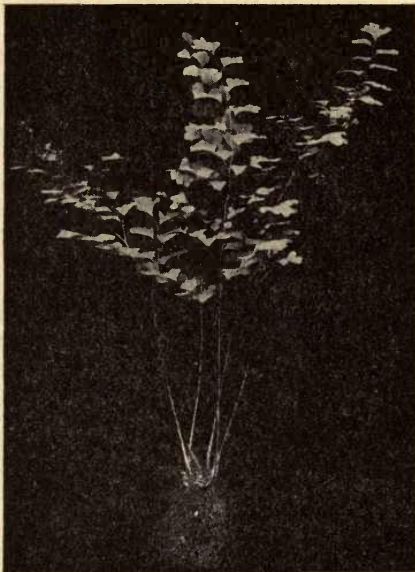
leaf. When the sporangia are mature the back of the Bracken frond, with its outline of bright brown, is very pretty. The number of spores produced is prodigious, and it is a common experience to find one's boots covered with the brown dust after walking through the fronds. It is believed that the Bracken is rarely propagated in a natural state by the agency of its spores. The strong-growing rhizomes provide a very effective method of increase, and as has been stated, the Bracken Fern is very quick to claim any land which has been allowed to go out of cultivation.

The Bracken Fern grows almost everywhere in the United Kingdom. It is, however, not able to hold its own on mountains of greater elevation than two thousand feet. There seems to be a popular impression that the Bracken is a difficult plant to grow in the garden. This is not really the case, the trouble, as a rule, arising from the careless manner in which the rhizomes are torn up when the plant is removed. The Bracken is, of course, a useful subject for placing in shrubberies and under trees, but seeing that the travelling rhizomes take up a great deal of room, it should be kept out of the ordinary borders.

Adiantum capillus-veneris. The generic name is connected with a Greek word *adiantos*, which means "dry or unmoistened," this having reference to the fact that water rolls off the frond of this Fern. *Capillus-veneris* simply means "the hair of Venus," and this doubtless refers to the shining black leaf-stalk and its delicate branches. The True Maidenhair.

This is one of the most beautiful of our native ferns, and it would probably have been exterminated long ago in this country were it not

that it so often grows in inaccessible positions. The True Maidenhair loves a position which is shady and where moisture is abundant. From a slender, creeping rhizome, which is black in colour, the fronds arise. These vary greatly in



Adiantum capillus-veneris. The Maidenhair Fern.

length, and may measure anything from six inches up to a foot, or even more, according to the conditions in which the plant is living. The stipes, which is usually about the same length as the leafy portion, is jet-black, and like the rachis and all its branchings, is of a very wiry nature. In a moderate-sized specimen the

arrangement of the frond would be on the following lines. On either side of the rachis the pinnæ are produced ; these usually branch alternately from the central stalk. The pinnæ bear fan-shaped pinnules, which are attached to the stalk of the leaf-division by very fine stalks. The margin of the pinnules is much



Adiantum capillus-veneris. Enlarged view of back of frond.

notched and veined. Where the frond is of a very large size they may be divided three times.

In the case of a fertile frond the edges of the pinnules are turned back in a very striking way. If we turn up the fold, it is possible to see the sporangia arranged on the underside. Before the fertile leaf has reached maturity the upper

part of the fold has a whitish appearance; finally it turns black.

The True Maidenhair Fern is more widely distributed than is generally supposed in the South of England and in Ireland. It is a delicate species, and, generally speaking, is restricted to those parts of the kingdom where the winter is mild. It may be seen growing abundantly on old quarries in Cornwall, as a rule quite out of reach. The Maidenhair Fern is a fairly easy plant to grow in pots, though it likes a moist atmosphere. Curiously enough, it is not so simple a plant to cultivate as some of the exotic species. The True Maidenhair is an evergreen plant.

Cryptogramme crispus. The generic name of this fern is derived from two Greek words, *krup-tos*, "hidden," and *gramme*, "a line," having reference to the fact that when mature the sori are arranged in lines round the margins of the fronds. The specific name, *crispus*, is an apt one, when the crisped or curled appearance of the barren fronds is considered. In some books this species is called *Allosorus crispus*. The Parsley Fern.

A very attractive species bearing both barren and fertile fronds. The former in their general appearance certainly bear a resemblance to Parsley. The Parsley Fern has a thick root-stock from which the fronds grow up in tufts. The barren fronds, which will be considered first, grow to the height of about six to nine inches. The stipes is somewhat longer than the rachis, and it is of a whity-green colour. The outline of the barren frond is roughly triangular, the apex of the leaf being rather blunt. The pinnæ are placed alternately on either side of the main stem, and these bear pinnules which

have their margins deeply cut. In very large specimens the fronds may be divided three times. The barren fronds grow on the outside of the tuft. The fertile frond is somewhat taller than the barren leaf, to which it bears a resemblance in its general form. The pinnæ, of course, are very much restricted. At first the sori are rounded, but as they mature they spread so as to form almost unbroken lines round the margins of the pinnules. The sori have indusia, but this is hidden by the margin of the pinnules, which are recurved.

There are few more local species than the Parsley Fern. The plant loves to grow amongst rocks which are often scattered about on the slopes of mountains. Its two chief strongholds seem to be the Snowdon district in Wales and the mountainous parts of Cumberland. In some localities of these districts the plant grows in the greatest abundance, happily often out of the reach of the tourist. The Parsley Fern has also been recorded in the West of England, and it occurs in Scotland. It is easily cultivated, if the fact is borne in mind that it is a rock species needing good drainage. It loses its bright, pretty colouring in a sunny position. The Parsley Fern sends up its green fronds in the month of May, and the fertile leaves follow soon after. The foliage disappears in the winter.

CHAPTER VI

THE MALE FERN AND ITS RELATIVES

A PART from the Bracken Fern which, as we have seen, is abundant almost everywhere, there are few ferns more common than certain of the leading members of the sub-order *Aspidiææ*. The British representatives of this sub-order include the important genus *Nephrodium*, of which the Male Fern is the leading example. In addition we have the Shield Ferns (*Aspidium*), and also some interesting species gathered together under the genera *Woodsia* and *Cystopteris*.

Nephrodium Filix-mas. The generic name is derived from the Greek *nephros*, "a kidney," this having reference to the kidney-shaped indusia which is typical of the genus; *Filix-mas*, of course, is a name formed of two Latin words, *felix*, "a fern," and *mas*, "a male." In some books the species is called *Lastrea Filix-mas*, and *Aspidium Filix-mas*. The Male Fern.

One is almost tempted to follow the example of the early writers of botanical works and to say that the plant is so well known that "it needeth no description." However, such a fine Fern, common though it be, is certainly as worthy of a notice as any species within the covers of this book. A very characteristic

feature of the Male Fern is its stout and sometimes very upright stem or caudex. In some



Nephrodium filix-mas. The Male Fern,

plants this is at times so large that it almost resembles a short trunk. It will readily be seen that the leaves arise from the outside of

the crown of the plant, whilst at the base of the stalks occur the fibrous roots. Within the circle of the developed leaves we may find the immature fronds; the least advanced of these may not develop for three years. The crown of the plant, as well as the stipes and the rachis, are more or less covered with brown scales. The length of the fronds of the Male Fern vary enormously. In a favourable situation the leaves may measure as much as three feet or more, though an average example would be a good deal less than this. A well-developed plant should show six or more finely developed fronds arranged cup-fashion round the central stem. The shape of the leaf of the Male Fern is roughly lanceolate, broadest in the middle and tapering at each end. The frond is bi-pinnate, and the pinnæ are long and taper to a fine point. The pinnules are rather blunt, and frequently show serrated edges. The upper portion of the frond is pinnatifid, and in many of the higher pinnæ it is only the pinnules nearest to the rachis that are distinct.

Practically all the fronds are fertile, though the sori occur chiefly on the upper portions of the leaves. The brown patches are to be found arranged in a single line on either side of the central vein of the pinnules. The sorus is circular and is covered with an indusium which is notched or kidney-shaped. In the early days the indusium is of a lead colour, but as the sporangia ripen underneath the brown colouring shows through the thin covering. The foliage of the Male Fern is of a bright green tint, changing to a duller shade as the leaves become older. Not uncommonly the fronds last in good condition through a

large part of the winter when the season is mild.

It is now recognized that the Male Fern may be divided into three sub-species. These are called *N. filix-mas* (true), *N. pseudo-mas*, and *N. propinqua*. The differences are not very obvious to the beginner, but it is said that the first named is only partially deciduous—the fronds lying prostrate during the winter. In the case of *N. pseudo-mas*, the fronds are of a leathery nature, and the plant is practically evergreen in sheltered positions. A well-established feature of *N. propinqua* is that the foliage completely dies away in the autumn.

The Male Fern is abundant in all parts of the United Kingdom where the conditions are in any way suitable. Naturally it is of easy culture in the garden. The new fronds, which are very pretty when they are uncurling, put in an appearance in the month of April.

Nephrodium Thelypteris. The specific name of this plant is a compound word derived from the Greek, meaning “ladyfern”; the title probably has reference to the delicate growth of the species. The Fern is also called *Lastrea Thelypteris*. The Marsh Buckler Fern.

This is a very attractive Fern, and perhaps the only British species which frequently grows in water. The Marsh Buckler Fern has a creeping rhizome from which arise the fronds at intervals; these are of two kinds, barren and fertile. The barren fronds sometimes reach the length of four feet, the stipes—which is slender and of a pale green colour—being about equal to the leafy portion. The fertile fronds are usually shorter. In both cases the outline of the fronds is the same, being lanceolate. In each case, too, the pinnæ

arranged alternately on either side of the rachis are cut almost to the midrib. In the case of the fertile fronds the pinnæ are perhaps a little more contracted; also the margins are inclined to bend over in such a way as to protect the sori. The clusters of sporangia are almost circular, and these are borne on the margins of the lobes on the underside of the pinnæ. The clusters of the sporangia are covered with small indusia which are slightly notched. The indusia are soon thrown off when the spore cases start to develop.

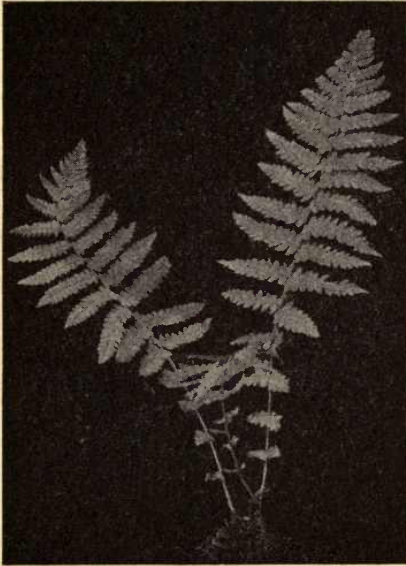
The Marsh Buckler Fern is not uncommon, and in suitably moist positions is often very abundant. It is, however, said to be rare in Scotland. The species will not flourish in a garden unless something in the way of a bog can be provided. The fronds appear in the spring and are cut down by the first frost.

Nephrodium oreopteris. The specific name is connected with the Greek word *oros*, "a mountain." In some books this fern is also called *N. montana* and *Lastrea montana*. In certain districts, varieties of the species are common. The Mountain Buckler Fern.

In certain respects this species bears a resemblance to the Male Fern. The fronds spring from a tufted rootstock and their outline is lanceolate; they are from one to four feet in length. The foliage of the Mountain Buckler Fern is of a pale green colour. A distinctive feature is the manner in which the frond of this Fern tapers to a point at both ends; this is even more pronounced at the base than at the apex. In the Male Fern any tapering at the base is of a very slight description. The Mountain Buckler Fern is once pinnate, the pinnæ being continued almost through the

entire length of the stalk; this makes the stipes very short. The pinnæ, which are generally placed opposite to one another, are cut very deeply.

The sori are much more abundant on the



Nephrodium oreopteris. The Mountain Buckler Fern.

upper portion of the frond; we shall find them on the back of the leaf along the margins of the lobes. They are covered by a very slight indusium, which soon falls off. In the Mountain Buckler Fern there are to be detected a number of tiny glands on the back of the frond; these are responsible for rather a

pleasant odour when the foliage is passed through the hand.

The Mountain Buckler Fern grows on heaths, and it has been found in almost all parts of the United Kingdom. In certain parts of Scotland it is said to clothe the mountain sides with a wonderfully vigorous



Back of frond of a typical *Nephrodium*. Enlarged.

growth. It is not, however, as its name seems to imply, strictly a mountain species; for it often grows in lowland districts. In cultivation, the species should be given a moist situation. The Mountain Buckler Fern dies down in the winter and the new fronds appear in the spring.

Nephrodium cristatum. The specific name of this Fern simply means "crested," and has

reference to the fringed border of the frond. It may be pointed out, however, that there are not a few Ferns on which the name *cristatum* could with more reason have been bestowed. This species is also called *Lastrea cristatum*. There are a number of forms of this Fern.

This is a very handsome Fern, and it is a pity that it is not more common. The fronds are somewhat oblong in outline and have a very narrow appearance. The rootstock has a creeping habit and sends up tufts of fronds at intervals. These are very erect, and usually measure between one and three feet. The stipes is shorter than the leafy portion, and it bears a few brown scales. The pinnæ are arranged alternately on the rachis and these are not again divided, although they are very deeply cut. The colour of the fronds is of a bright green.

The sori are borne in lines on either side of the mid-vein of the lobe. These are covered at first by an indusium which is notched after the manner of that of the Buckler Ferns.

The Crested Buckler Fern is very rare, though it is found in a few localities—chiefly in the North of England. As a rule it occurs on boggy heaths, and if these conditions can be imitated in the garden, the Fern grows freely. The fronds are soon cut down by the autumn frosts, and the new growth does not appear until May.

Nephrodium spinulosum. The specific name means that the plant has little spines. This Fern is associated with other forms, and in some quarters has not been regarded as a definite species at all. Some of the varieties, or, as some authorities say, actually distinct species, with which it is associated have been called

N. dilatatum and *N. uliginosa*. It may be mentioned that some botanists consider *N. dilatatum* to be the most important of the three forms. The chief points about *N. dilatatum* are the very dark green fronds which are extremely broad at the base; these spring from a massive caudex. The whole plant has a very robust appearance, and it is exceedingly common. Providing the situation is shady this



Nephrodium dilatatum.

Fern is not particular as to its place of growth. In the same way the preceding species *N. cristatum* is regarded by some as a doubtful species. On this account the beginner will find *N. spinulosum* rather difficult to identify, and he must be prepared for departures from the present type which is here described. The Prickly Buckler Fern.

The frond of this species rises from an erect root-stock. The length of the leaves varies from one to three feet, and the stipes is usually about

a third of this in measurement. The fronds are triangular in outline, and it is seen that the pinnules nearest to the rachis are considerably larger than the upper ones. This gives a very tapering appearance to the pinnæ. The borders of the pinnules are deeply cut, and the lobes are adorned with tiny points which give a somewhat prickly appearance. The lobes are most prominent on the lowest pinnules, and are also far more pronounced on the lowest pinnæ than they are on the upper divisions of the frond.

The sori are placed on small veins which grow outwards from the midrib of the pinnule. These are covered with kidney-shaped indusia. As has been indicated, the Prickly Buckler Fern varies enormously, both in size and in almost every other particular.

The Prickly Buckler Fern is not uncommon in parts of England, and is to be found in damp woods, especially by the sides of streams. It seems to be less abundant in other parts of the kingdom. It is of easy culture in the garden. The Prickly Buckler Fern retains its fronds through the winter.

Nephrodium æmulum. Here the specific name is taken from a Latin word meaning "comparable with"; the reference is to the similarity of the species of *N. spinulosum*. Some botanists have considered that *N. æmulum* is merely a variety of *N. spinulosum*, though the species seems to be quite distinct. The species is also called *Lastrea æmula*; *L. fœniscii* and *L. recurva*. The Hay Scented or Triangular Buckler Fern.

A very characteristic feature of this species are the upturned margins of the fronds. This makes the leaf look as if it was curled, and at the same time renders the upper surface of the

frond concave. The outline of the fronds is roughly triangular, being widest at the base. The fronds are about one or two feet in length, and the stipes is about equal to the leafy portion. The pinnæ are arranged either in pairs or alternately on either side of the stalk. These are divided into pinnules which, in some cases, towards their bases are again divided. The fronds are of an exceptionally bright green colour, and when bruised give out a pleasant odour not unlike that of new hay. This is due to the secretions of small glands which are to be found on the undersides of the fronds.

The sori on the backs of the fronds are arranged in lines on either side of the mid-veins of the lobes. These are covered with kidney-shaped indusia.

The Hay Scented Buckler Fern cannot be said to be common, although it has a wide distribution and may turn up in unexpected places. It is more abundant in the West of England and in Ireland than elsewhere. It only flourishes in damp places, and this point must be borne in mind when planting it in the garden. The Hay Scented Buckler Fern is an evergreen species.

Nephrodium rigidum. The specific name—Latin for “stiff”—is evidently bestowed on the plant on account of its erect habit of growth. The species is also called *Lastrea rigida*. The Rigid Buckler Fern.

This species is quite the rarest of all the Buckler Ferns. The plant has a thickish root-stock from which arise the fronds, usually about a foot in length. The stipes is, as a rule, about half the length of the entire leaf; the bare portion of the stalk is thickly covered with brown scales. The outline of the frond is somewhat variable; on occasion, examples may be

found with a lanceolate outline, whilst others may be distinctly triangular in shape. The frond is bi-pinnate, the pinnate being placed rather irregularly on either side of the rachis. The pinnules are blunt and somewhat oblong in shape; they have serrated edges, but do not bear any spines.

The sori are placed on either side of the vein in the middle of the pinnules. These are covered in their early stages with kidney-shaped indusia. Sometimes this frond has a slight fragrance when it is bruised.

The Rigid Buckler Fern is really a mountain species, and generally grows at an elevation of more than a thousand feet above sea-level. It is fairly common in parts of Yorkshire and in some of the north-western counties of England, otherwise it is a real rarity. It is not difficult to grow in the garden, but as it flourishes best in a limestone soil it is a good plan to mix bits of this rock up with the soil which is used. The new fronds appear in May and die down during the winter.

Polystichum (Aspidium) lonchitis. Here the generic name is based on two Greek words, *polys*, "many," *stichos*, "order"; the specific name is also derived from another Greek word—*lonche*, "a spear," this referring to the narrow spear-like appearance of the fronds. The Holly Fern.

This species, on account of its regular habit of growth and generally stiff appearance, is an easy one to identify. The fronds arise from a tufted root-stock, and in average specimens would be about nine inches in length. This might be greater or less, according to the conditions under which the particular plant was living. The shape of the fronds is narrowly lanceolate, and

there is a very short stipes which is thickly covered with scales. The leaves of the Holly Fern are once pinnate, the pinnæ being ovate and having a curious ear-shaped enlargement at their bases on the upward side. The edges of the pinnæ are adorned with a number of sharp teeth, and this gives a singular spiny appearance to the whole plant. On this account the Fern has probably received its popular name of



Polystichum lonchitis. The Holly Fern.

Holly Fern. The colour of the foliage is of a very pretty bright green tint.

The Holly Fern, as indeed are all the species of *Polystichum*, is very distinct from a *Nephrodium* in the matter of its indusium. This is quite circular, and has no notch; moreover, it is attached to the pinnules by a short stalk in the centre. Thus it is proper to describe the shape of the indusium as peltate. The sori are chiefly confined to the upper portion of the back of the frond, and are situated on either

side of the midrib of the pinnæ. After the falling away of the indusia the sori tend to spread, so that they may finally cover almost the whole of the back of the fertile pinnæ.

The Holly Fern is essentially a plant of the mountains, and it is often found growing in the most exposed situations. It is not common in England, though it has been found in a few localities in the north. The species has a much wider distribution in Scotland. The Holly Fern is evergreen in habit, and its stiff fronds seem to be able to withstand the severest frost. The plant is rather a difficult one to grow, though if it can be given a rock crevice it will sometimes settle down happily in the garden. The foliage of the Holly Fern lasts through the year.

Polystichum (Aspidium) aculeatum. In this case the specific name is a Latin term simply meaning "provided with prickles"—an allusion to the fact that the fronds are adorned with spines. The Hard Prickly Shield Fern.

This species is very distinct in its general appearance from the Holly Fern, though it can at once be seen to be a Shield Fern by the unnotched indusia which cover the sori. The fronds may be as much as two feet in height, or even a little more, and these rise from a tufted root-stock. As a rule the stipes is very much shorter than the leafy portion, and both it and the rachis are thickly covered with scales. The outline of the frond is lanceolate, and the colour of the foliage is dark green. A pretty glossy effect is noticeable on the upper surface. The frond of the Hard Prickly Shield Fern is twice divided, and the pinnæ are arranged alternately on either side of the rachis. A distinctive point about this species is that the upper pinnules at the base of each pinna is larger in all ways than

the other pinnules. The pinnules are provided with sharp teeth, and it should be noted that they have nothing very decided in the way of stalks. Actually they are what botanists call decurrent—that is, tending to run together at the base. In some varieties of this species the tendency is more marked than in others.

The sori are placed on either side of the midveins of the pinnules, and these are usually confined to about half the upper portion of the back of the frond.

The Hard Prickly Shield Fern is very widely distributed in England, and it is to be looked for in shady woods. It is an exceedingly easy plant to grow, and thrives even in town gardens. The plant is evergreen in habit.

Polystichum (Aspidium) angulare. It is not regarded by some botanists as an established species, but is thought to be a variety of *A. aculeatum*. However, there are certain differences which appear to be specific. The Soft Prickly Shield Fern.

As in the Hard Prickly Shield Fern, we find a tufted root-stock from which grow lanceolate fronds. We notice the same short stipes and the narrow pinnæ on the leafy portion tapering to a point. In this species it is said that the pinnules at the base are more nearly equal in size than is the case with *A. aculeatum*. The pinnules are also more definitely stalked in the former than in the latter. In the case of the Soft Prickly Shield Fern, it is noticeable that all parts of the stalk of the frond—both stipes and rachis, and even the rachides—are covered with brown scales. It is said, too, that the droop of the fronds is more pronounced in the Soft Prickly Shield Fern than in the Hard Prickly Shield Fern.

The arrangement of the sori is similar in both species.

The Soft Prickly Shield Fern has been found widely distributed in England and Ireland, though it is not so common in other parts of the United Kingdom. It is easily cultivated, and is evergreen in habit.

Woodsia hyperborea. The generic name of this species commemorates the botanist, Mr. Joseph Woods ; the specific name is taken from two Greek words—*hyper*, “beyond,” and *Boreas*, “the north wind,” without doubt a reference to the fact that the species extends to the Arctic regions. The plant is also called *Woodsia alpina*. The Alpine Woodsia.

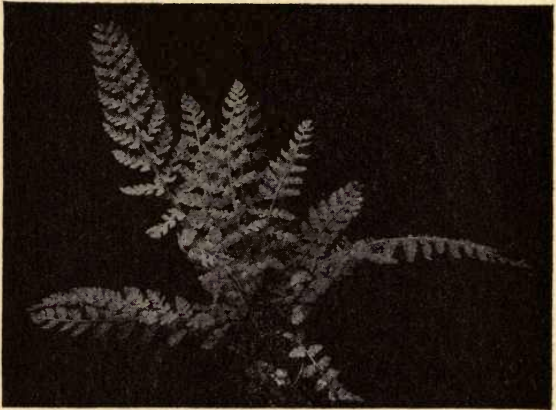
This is a very pretty little Fern. The tiny fronds, which are not more than two or three inches in length, spring from a tufted root-stock. The stipes is rather short and bears a few brown scales. The outline of the frond is oblong, and the leaf tapers slightly towards the base as well as at the apex. The fronds are once pinnate, and the pinnæ, which are lobed, are arranged in rather an irregular fashion on either side of the leaf-stalk. A curious feature of the Alpine Woodsia is that the fronds are jointed just above their connexion with the root-stock. When the leaves die the stalks break away at this point and leave the bases behind.

When the back of the frond is examined it is evident that we have here a very distinctive feature. The patches of spore cases are covered with a very thin indusium, and as time goes on this splits into divisions which resemble a number of hairs. The fronds are of rather a stout texture for so small a Fern, and in all parts show an inclination to be hairy.

The Alpine Woodsia is a very rare Fern, and

there are only a few recorded localities of it in England and Wales. It makes its home on moist rocks on the slopes of high mountains. This little Fern is fairly easily cultivated. The fronds disappear in the winter.

Woodsia ilvensis. The specific name refers to the island of Elba (Ilva), where this plant was first of all discovered. In some quarters this



Woodsia ilvensis. The Oblong Woodsia.

plant is held to be merely a variety of *W. hyperborea*. The Oblong Woodsia.

The fronds of this Fern rise from a tufted root-stock. The stipes is short, but the frond as a whole is larger than that of the Alpine Woodsia, and may be as much as six inches in length. The outline of the fronds is oblong, tapering towards the base and at the apex. Over the whole frond, both on the upper and the lower side, is a covering of fine hairs. Usually the hairiness of the Oblong Woodsia

is very pronounced. The covering is so thick on the underside that it is rather difficult to discover the sori. These have the same curious divided indusia to be observed in the Alpine *Woodsia*.

The Oblong *Woodsia* is a very rare Fern, only to be found in mountainous districts. It has been reported from a few localities in England and also occurs in Scotland, usually in almost inaccessible places. The fronds die down in the winter and break away from the stem just at the crown of the root-stock.

Cystopteris fragilis. The generic name of this Fern is formed of the two Greek words *kystos*, "a bladder," and *pterus*, "a fern." The specific name is, of course, a Latin word which means "easily broken." The Brittle Bladder Fern.

This is one of the most beautiful of all our native Ferns. From a tufted root-stock which is clad with pale brown scales the fronds arise; these are about six or eight inches in length and are lanceolate in outline. This Fern has a habit of spreading in such a way, that each plant may have several of the tufted crowns from each of which arise a cluster of fronds. These are sometimes once, and on other occasions, twice pinnate. The pinnæ are about an inch in length, and where there are pinnules these are toothed.

We shall find the sori on veins which run from the mid-vein of the pinnules. The spore patches are rounded and are covered with a curious indusium, with an inflated appearance towards the centre. It is from the resemblance of this indusium to a bladder that the plant has received its popular name. With the disappearance of the indusia the sori tend to spread over the whole surface of the back of the frond. The general

appearance of the Brittle Bladder Fern is of a delicate nature and it has a very distinctive appearance.

Properly speaking, the Brittle Bladder Fern is a mountain species, though it sometimes occurs on old walls or in rocky clefts which are not very elevated. The species is widely distributed in all parts of Great Britain, though in frequented districts it is soon exterminated. The Brittle



Cystopteris fragilis. The Brittle Bladder Fern.

Bladder Fern does not seem to grow very well in the open rockery, though it is fairly easy to cultivate in pots. The fronds die down at the approach of winter. There are a certain number of varieties.

Cystopteris montana. Here the specific name is formed from the Latin word *mons*, "a mountain." The Mountain Bladder Fern.

This is the only other recognized species of Bladder Fern to be found in the United King-

dom. The species has a slender creeping underground stem from which arise the delicate fronds. These are usually about four to eight inches in length, and the stipes is considerably longer than the leafy portion. The design of the frond is rather like that of the three-branched Polypody, this being due to the fact that the lowest pair of pinnæ is much larger than any of the others.

The general outline of the fronds is wedge-shaped, and these are very finely divided. Indeed in a well-developed leaf the fronds may be three or even four times pinnate. The pinnules themselves are also deeply cut. It will be noticed that the lower portion of the frond is always more freely divided than the upper part ; a common characteristic in Ferns.

The sori are very freely scattered on the lobes or pinnules at the back of the frond, and these are covered with the curious hooded indusia which were noticed in the last species.

The Mountain Bladder Fern is perhaps the rarest of all our native species. It is at home in mountainous districts, and seems only to have been noticed in a few localities in Wales and Scotland. Probably it would be seen more often were it not that it grows in positions which are not of easy access. It should be given the same treatment in the garden as that recommended for the Brittle Bladder Fern. The fronds disappear in the winter.

In some books a species is given, known as *Cystopteris alpina* or *regia*. The plant nearly resembles *Cystopteris fragilis*, although it is somewhat smaller. This is a very doubtful native, as it seems only to have been recorded in one or two localities where it may have been naturalized.

CHAPTER VII

THE LADY FERN AND THE SPLEEN- WORDS

THE sub-family *Asplenieæ* has a large number of representatives in the United Kingdom. There is much division of opinion as to the real place of the Lady Fern. Many botanists consider that the species is a true *Asplenium*. Others regard it as the solitary British representative of the genus *Athyrium*. All Fern growers support the latter view. Some of the small Spleenworts are quite common.

Athyrium or *Asplenium Filix-fœmina*. The generic name of the Spleenworts is derived from the Greek word *splene*, "the spleen," this having reference to the fact that in the old days a medicine derived from the leaves was held to be a remedy for diseases of the spleen. The specific name is simply a combination of two Latin words—*Filix*, "a fern," and *fœmina*, "a woman,"—that is, "Lady Fern," a name no doubt given on account of the elegant appearance of this species, particularly when it is compared with the Male Fern (N. *Filix-mas*).
The Lady Fern.

Although it is altogether more fragile in appearance, the growth of the Lady Fern bears a resemblance to that of the Male Fern. We notice the same tall fronds rising from a stout

root-stock covered with brown scales. In a favourable situation, such as a damp hedge,



Athyrium filix-femina. The Lady Fern.

these fronds may grow to the length of four feet, or even more. They are of a beautiful pale green colour, and being of a thin texture

soon disappear at the approach of winter. The stipes is usually about one-third of the whole leaf, and is sometimes of a brownish colour. The stalk is remarkable for its brittle nature. The outline of the fronds is lanceolate, and they taper very decidedly towards the base as well as at the tip. The leaves of the Lady Fern are bipinnate. The pinnæ are placed either in pairs, or alternately, on opposite sides of the rachis, and these in turn are divided into toothed pinnules. In the case of both the pinnæ and the pinnules the distinctiveness is lost towards the upper portion.

The sori are very abundant, but as these are small they should be carefully examined. They occur about midway between the central vein of the pinnule and the margin of the leaf. The indusium is not clearly linear, being more in the shape of a horseshoe, but this character can only be recognized before the delicate covering has started to shrivel. There are a huge number of variations of the Lady Fern, but many bear a more or less striking resemblance to the type.

Happily the Lady Fern is common in many parts of the United Kingdom. Often it is to be found growing surprisingly near to towns, though its pretty green foliage makes a strong appeal to the eye of those vandals who go about uprooting every fern which they see. It is of easy culture in the garden. The fronds of the Lady Fern develop in the spring of the year.

Asplenium septentrionale. The specific name means "northern," and this has reference to the fact that the species is more abundant in the north than in the south. The Forked Spleenwort.

The fronds of this Fern are of a thick leathery nature, but they are rarely more than about two

inches in length. As they are produced in thick tufts, the individual plants will often cover a good deal of space, considering the diminutive nature of the plant as a whole. The stipes is considerably longer than the leafy portion of the frond; this latter is of a very simple nature, being composed of two or three blades which fork out something on the lines of a stag's horn. The plant is quite unlike any other British Fern, although its foliage bears a singular resemblance to that of the Buck's Horn Plantain (*Plantago coronopus*), a common enough weed, especially on waste patches near to the sea.

On the underside of the narrow blades are produced the sori; these are present in the form of lines on either side of the mid-veins. At first they are covered with scale-like indusia, but as the sporangia ripen the protecting shield is thrown aside. Finally, the capsules spread out so as to cover almost the whole of the underside of the blade.

The Forked Spleenwort finds its home in the fissures of rocks and in the crevices of old walls. It is, however, a rarity, less uncommon in the North than in the South of England. Now and again it has been recorded in great abundance in a particular spot, and it is difficult to understand why the species is not more widespread in its distribution. The Forked Spleenwort can be grown in gardens if suitable rock crevices are provided. The plant is an ever-green species.

Asplenium germanicum. It is uncertain what is the derivation of the specific name *germanicum*; in some quarters it has been said that the name was given owing to the fact that the Fern is a very popular one in Germany, though whether this is a true explanation cannot be

stated with certainty. The Alternate-leaved Spleenwort.

This species is somewhat larger than the last-named, though it is hardly so striking in appearance, owing to the comparatively small number of fronds which are produced. These will, as a rule, be about four or five inches in height, and they arise from a tufted root-stock. The stipes is about the same length as the leafy portion of the frond. The rachis bears alternately curious wedge-shaped pinnæ. At the broad end these pinnæ are toothed, and these segments are more pronounced on the lower than on the upper pinnæ. The fronds are of a fairly tough texture.

On the backs of the pinnæ we shall find the sori, two or three lines of the collections of sporangia being present on each division of the frond. At first these are covered with an indusium, but as the capsules ripen this is thrown away and the clusters join together in one mass.

The Alternate-leaved Spleenwort is very rare. It is, however, known to occur in a few rocky localities in England and Scotland. Probably it is often overlooked by the few people who visit the more inaccessible parts. It has proved to be rather a difficult subject to grow, and it has a most annoying habit of dying off suddenly, even when given a great amount of care. Probably the real trouble is that it is given too much water; good drainage would go a long way to meet the difficulty. The fronds of the Alternate-leaved Spleenwort sometimes survive the winter.

Asplenium ruta-muraria. In this case the specific name simply means "wall rue," and refers to the resemblance which the Fern bears

to the Common Rue (*Ruta graveolens*). The Wall Rue.

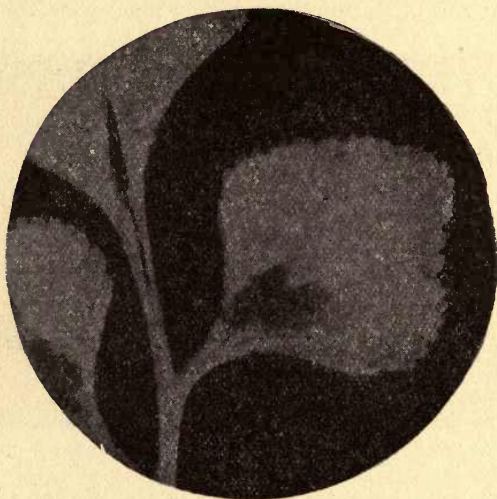
A very charming little species, with which most people who take the least interest in Ferns are probably familiar. In reality this plant is a rock Fern, but it often finds a congenial home on old walls. The Wall Rue has a tufted root-stock which is furnished with a quantity of fibrous roots; these often force



Asplenium ruta-muraria. The Rue-leaved Spleenwort.

their way for a considerable distance into the crevices. From the root-stock arise a number of little fronds; where the situation is dry, and the battle for existence is a hard one, these may not be more than a couple of inches in length. In damp situations the fronds might measure three times as much. Where the examples are dwarfed the stipes will be about the same length as the leafy portion, but in a well-developed instance it will be much longer. The colour of the fronds is of a

dark green colour, and these are of a somewhat leathery nature. In a fair-sized example the frond is twice pinnate, the pinnæ are definitely stalked, and the pinnules are roughly wedge-shaped, being somewhat toothed at the tip. The Wall Rue is excessively variable, and in exposed places it is possible to find plants



Back of frond of *Asplenium ruta-muraria*. Enlarged.

bearing fronds which are only divided once, the pinnæ being segmented.

The sori are in the form of lines which branch out from the lower part of the pinnule in a fan-shaped manner. The indusium disappears as soon as the sporangia become mature, and eventually the sori may spread over the whole of the back of the pinna or pinnule.

The Wall Rue is really a very common Fern, but it is often overlooked when hiding in the dark crevice of some old wall. The plant has a wonderful habit of adapting itself to dry conditions. It is of easy cultivation if it can be given an open and well-drained situation. The Wall Rue is an evergreen plant.

Asplenium adiantum-nigrum. In this case the specific name is formed of two words, the first of which belongs to the true Maidenhair Fern. As has already been explained, it comes from a Greek word which means "unwetted," a reference to the fact that the fronds do not become damp when it rains. The word *nigrum*, of course, simply means black, and is obviously an allusion to the colour of the leaf-stalks of this Fern. The Black Maidenhair Spleenwort.

A very pretty Fern, which in some ways is to be regarded as the most attractive of all the Spleenworts. The species varies a good deal according to the situation in which it is growing. Thus in dry hedge-banks it will be a comparatively small Fern, whilst when growing in damper situations—such as by the side of a waterfall—it will be very much larger. The root-stock is thick and is densely covered with scales, and from it arise the leaf-stalks, which are black towards the base. The stipes is usually about the same length as the leafy portion. In the varying forms the fronds range from about four inches to a foot, or even more, in length. In the smaller examples the fronds are twice pinnate, whilst the larger leaves may be thrice pinnate. The general outline of the frond is triangular, and the pinnæ, which are arranged alternately on either side of the rachis, are somewhat similar

in outline. The pinnules are shaped like wedges and have toothed lobes.

If we turn up a frond of the Black Maiden-hair Spleenwort we shall discover the sori situated on veins which issue from the mid-veins of the pinnules. In their early days these clusters are distinctly in the form of lines, but after the throwing off of the indusia they rapidly mature and spread to such an extent that the whole of the under-surface of the pinnule is covered. Often an entire frond appears to be completely brown on its underside.

The Black Maidenhair Spleenwort is an exceedingly common Fern. It occurs in almost all parts of the United Kingdom, although, of course, near towns it is usually rooted up. The species is of very simple culture and will be quite happy on an ordinary rockery. The Black Maidenhair Spleenwort retains its fronds throughout the winter.

Asplenium lanceolatum. The specific name has reference to the fact that the outline of the frond is lanceolate. The Lanceolate Spleenwort.

This is a species which in its early days is sometimes confused with the Black Maiden-hair Spleenwort. The fronds, which are lanceolate in outline and about four inches to a foot in length, arise from a tufted root-stock; the stipes is usually about a third of the frond. The colour of the stipes, and also part of the rachis, is bright brown, and this contrasts finely with the handsome green of the leafy portion. The actual length of the fronds will vary to a considerable extent, this depending upon the amount of moisture available. The design of the frond, when it

is developed, shows by its lanceolate outline a marked feature which distinguishes it from the triangular outline to be seen in the case of the Black Maidenhair Fern. The frond is twice pinnate, and as a rule the pinnæ are opposite; these are roughly egg-shaped in form. The pinnules have serrated margins.

The sori are placed on veins which branch out from the mid-veins of the pinnules. At first the collections of sporangia are long and narrow, and covered with a white indusium. As the capsules mature the sori spread out over the under-surface of the frond.

The Lanceolate Spleenwort is usually met with near to the sea or in mountainous districts. It is rather local, although it sometimes occurs in great plenty on damp rocks. It is said not to occur in Scotland. In a suitable rocky corner there is no reason why the Lanceolate Spleenwort should not be grown in a garden. The situation should be well drained, but a sufficiency of water is needed. The Lanceolate Spleenwort remains green throughout the winter.

Asplenium marinum. The specific name *marinum* has, of course, reference to the fact that the Fern is to be found near the sea. The Sea Spleenwort.

This is an interesting and a most beautiful species, often growing abundantly from the roof-crevices of caves on the coast. The root-stock of this plant is stout, and from it are produced a large number of fine black roots which penetrate into the rocky fissures. The fronds are, as a rule, four or five inches in length, though in favourable situations they may be very much longer. The stipes is somewhat short, hardly ever more than a third of the

length of the frond, and sometimes less than this. In most cases the stipes is of a purple colour, and the leafy portion of the frond is of an exceptionally fine green shade. The leaves are freely produced in tufts and are roughly lanceolate in outline. The fronds of the Sea Spleenwort are only once pinnate, the pinnæ—which are usually about an inch in length—being, as



Asplenium marinum. The Sea Spleenwort.

a rule, oblong in outline. They are, however, decidedly variable in form, some being egg-shaped. A curious feature of the pinnæ is that they are unequal in shape at the base, the lower part appearing to have been cut off whilst the upper portion is greatly enlarged. Between the lower pinnæ the rachis is winged, but this feature disappears at the tip of the frond where the pinnæ run together.

The sori are to be found on the underside of the pinnæ, arranged in lines on either side of the

mid-veins. During the early days the cluster of sporangia is covered with very distinct indusia, but as the capsules ripen, these disappear.

The Sea Spleenwort is hardly ever found at a great distance from the sea. It is most common on the coast of southern and western England, sometimes appearing in great abundance in rocky caves. The species also occurs in other parts of the United Kingdom where there is a rocky coastline. Happily it often grows in inaccessible places, and even where the plant can be reached with ease it is extremely difficult to tear the root-stock from its crevice. It seems to be almost impossible to grow the Sea Spleenwort in the open garden, although it is readily cultivated under glass. The species is evergreen in habit, though the foliage will not stand frost.

Asplenium ceterach. The specific name is considered to be a corruption of *Chetherak*, a name given to this Fern by early medical writers. In some books the species is called *Ceterach officinarum*. The Scaly Spleenwort.

This is the most distinctive of all the Spleenworts. The root-stock of the plant is tufted and scaly, and from this are sent down dense masses of roots which penetrate into the remote recesses of the wall or rock crevice where the Fern has made its home. The fronds vary greatly in length, and in a very exposed situation may not be more than an inch or so; in a sheltered and moist place they will be two or three times this size. The outline of the fronds is lanceolate. Strictly speaking, the fronds of the Scaly Spleenwort are pinnatifid, the leaf being designed with rounded lobes and deeply cut intervals. When held lengthways an idea is obtained of the wonderfully regular manner

in which the cutting-out of the lobes has been devised. The segments of the fronds occur alternately on the rachis.

At first glance it is not an easy matter to discover the sori, for the back of the frond of this Fern is completely covered with brown scales; these are, however, white in the early days of the leaf.

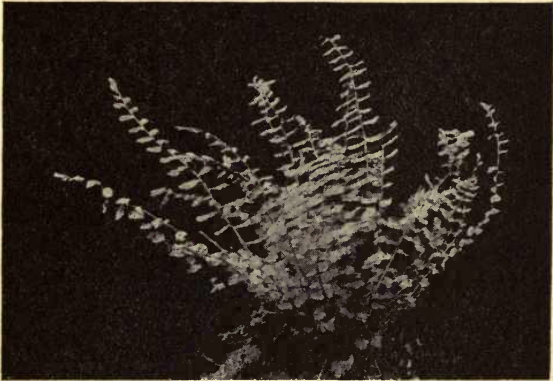
By removing the scales it is possible to see the groupings of the sori; these are arranged in the form of rough lines. There is no very clear indication of an indusium, and indeed when one considers the protective scales this hardly seems to be necessary. It is generally considered that the scales on this Fern act in a protective manner during the long spells of dry weather. In such a condition the fronds of the Scaly Spleenwort appear to be trying to roll right up, whilst the lobes close in towards each other. To all appearance the plant is dead. It soon revives, however, after a good shower of rain.

The Scaly Spleenwort is to be looked for in limestone districts, where it occurs on old walls or amongst rocks, often in great abundance. It is said to be less common in Scotland than in other parts of the United Kingdom. Under cultivation the Scaly Spleenwort often comes to grief through excessive moisture; it is most happy in a crevice on a rockery. The Scaly Spleenwort is an evergreen plant.

Asplenium trichomanes. The specific name is probably formed of two Greek words—*thrix*, "a hair," and *manos*, "soft." This is doubtless a reference to the hair-like nature of the leaf-stalks. The Maidenhair Spleenwort.

This is a very familiar Spleenwort, not infrequently sold as the English Maidenhair. The plant has a stoutish root-stock, from which grow

a quantity of fine roots ; these often penetrate for a long way into the crevices of the rocks, or between the building materials of an old wall. The length of the fronds varies from a few inches to nearly a foot. The stipes is very short and is extremely brittle. On either side of the rachis, which is of a deep purple colour, the pinnæ are produced. These are borne on a very short stalk and are of an oval shape, being about



Asplenium trichomanes. The Maidenhair Spleenwort.

half an inch in length. The margins of the pinnæ are occasionally slightly toothed. As a rule, the pinnæ are set in opposite pairs on either side of the rachis. A curious feature of the leaf-stalks of the Maidenhair Spleenwort is that they do not decay at once when the pinnæ fall off. Thus it is often possible to find thick bunches of them on the root-stock looking like so much dark hair.

The sori are placed in the form of lines on veins which branch from the mid-vein of the

pinnae. In the early days the clusters of spore capsules are covered with indusia; as the capsules mature these are thrown off, and finally the sori may spread over the back of the pinnae.

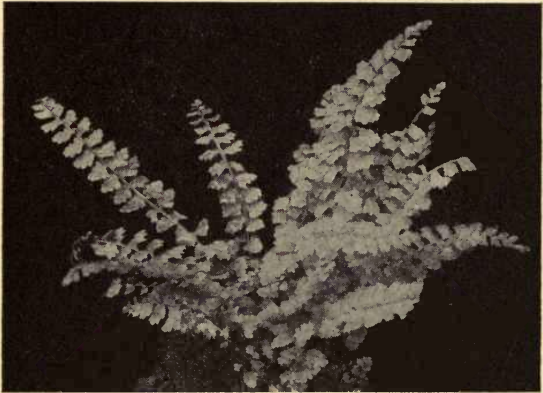
The Maidenhair Spleenwort is an exceedingly common Fern in many parts of the United Kingdom. It is often found on old walls in great abundance. Happily it is not an easy plant to exterminate; for, owing to the long roots already mentioned, it is a difficult matter to dislodge a plant from its crevice. In the garden the Maidenhair Spleenwort is perfectly happy on a rock ledge; it should not be given a large amount of moisture. The Maidenhair Spleenwort is an evergreen species.

Asplenium viride. Here the specific name is formed of the Latin word *viride*, "green," obviously a reference to the bright colour of the fronds. The Green Spleenwort.

In some respects this species resembles the Maidenhair Spleenwort, though there are certain important distinctions. In the first place, there is the bright green colour of the whole plant; this is very different from the dull shade of the Maidenhair Spleenwort. The Green Spleenwort also grows in damp situations, and would not be at all happy on the top of a wall. Most distinctive of all, the Green Spleenwort has a bright green rachis to its fronds, although the stipes has a tendency to be purple in colour. In other respects the two plants are very similar. We notice the same narrow frond with the rounded pinnae set on either side of the rachis, sometimes in pairs and sometimes in alternation. The margins of the pinnae are inclined to be notched.

The sori are narrow, and when young are covered with an indusium. It is said that even when ripe the sporangia hardly ever spread over the entire surface of the pinnæ, as is to be seen in the case of the Maidenhair Spleenwort.

The Green Spleenwort is a much rarer species than the Maidenhair Spleenwort. It grows in wild and often mountainous situations in various parts of the United Kingdom. As



Asplenium viride. The Green Spleenwort.

has already been indicated, it likes rather damp situations, and is to be seen at its best in moist places. The Green Spleenwort is rather a difficult plant to grow in the garden, and it is happiest of all in a humid greenhouse—unless, of course, a very favourable situation can be found out of doors. The fronds of the Green Spleenwort generally last through the winter.

Scolopendrium vulgare. In this case the

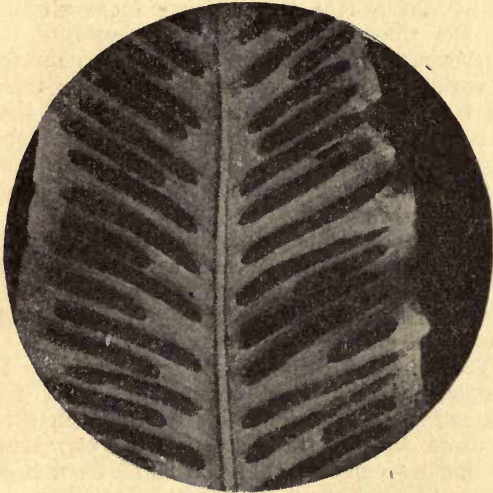
generic name is derived from *scolopendra*, the Latin name for a "centipede"; this has reference to the supposed resemblance of the lines of spore cases to the legs of a centipede. The specific name is, of course, simply Latin for "common." The Hartstongue.



Scolopendrium vulgare. The Hartstongue.

This is certainly one of the most familiar of all British ferns. Almost alone amongst the well-known species, the plant has an uncut frond. The leaves rise from a tufted root-stock which generally stands well above the level of the ground. The length of the fronds

varies considerably, and in a mature plant which has found a damp corner these are sometimes two or three feet in measurement. Where the plant has found a home on a dry wall, however, it may be a very diminutive affair. As a rule, the stipes will be about one-third of the whole frond, the leafy portion



The sori on the back of a Hartstongue frond.

being long and tongue-shaped. At the tip the frond ends in a point, whilst towards the middle the leaf swells out again, narrowing once more towards the base and finally expanding again into a couple of ear-shaped projections. The rachis of the Hartstongue Fern is a very prominent feature, and at the back of the leaf appears in the form of a ridge.

From the rachis arise veins which run out to the borders of the frond, and parallel to these are the linear sori. Although at first sight this is not very apparent, the brown lines are composed of two sori which practically join together. The pairs of sori are covered with pairs of indusia which, on the maturity of the sporangia, open out opposite to each other. As a rule the sori are most plentiful on the upper portion of the frond of the Hartstongue. There are an immense number of varieties of the Hartstongue, some of which are familiar garden subjects. In a wild state it is not an uncommon thing to find fronds which are abnormal, and some of these show a greater or less tendency to develop fronds which are branched.

The Hartstongue is an excessively common Fern, often occurring in the greatest abundance. It is said to be less frequent in Scotland than in other parts of the United Kingdom. Naturally it is of the simplest culture in the garden.

There is much division of opinion as to the position of the Fern, which we must now consider. In some quarters it has been given a place among the Spleenworts, but many authorities consider that the Hard Fern is the solitary British representative of its class.

Blechnum spicant. In this case the generic name is derived from a Greek word *blechnon*, a name for a Fern. The specific name, *spicant*, is from the Latin *spica*, "a point." The application of the name is realized when the sharply-pointed pinnae are examined. The species is in some books called *Lomaria spicant* and *Blechnum boreale*. The Hard Fern.

This species has a rather thin root-stock, from which arise large quantities of wiry

roots. From the crown the two kinds of fronds are sent up. We may first consider the barren fronds: these vary according to the conditions under which the plant is growing, and range from a few inches up to one or two feet in height. The stipes is very short and it is of a brownish colour, with a few scales. The leafy part of the frond is narrowly lanceolate, tapering slightly at the point but more decidedly at the base. On either side of the rachis, which is green, are arranged the pinnæ; these are not opposite, but are in alternation. The pinnæ are narrow and oblong, and at the tip the frond tends to become pinnatifid, whilst at the base the pinnæ are little more than rounded lobes. The frond has been not inaptly likened to a double comb. The fertile frond has much the same outline as the barren one; it is, however, easily distinguished by its greater length and the extremely narrow pinnæ. These fertile fronds arise from the centre of the clump and are at their best about the month of June. They are very erect in their growth. The sporangia are borne along the margins of the pinnæ of the fertile fronds. The borders of the pinnæ seem to curl over and protect the sporangia; by a close examination it is easy to discover the independent indusia. When the spore capsules ripen they spread so that the whole of the underside of the pinnæ is covered. The texture of both the barren and the fertile fronds of the Hard Fern is very leathery.

The Hard Fern is, of course, a very common species, to be found all over the United Kingdom. The plant is of a simple culture and is evergreen in habit.

CHAPTER VIII

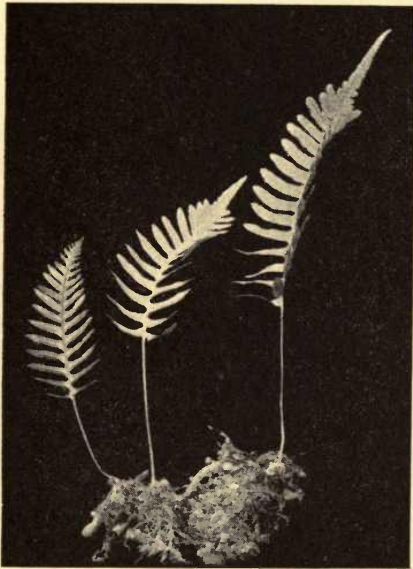
THE POLYPODIES

THERE must be very few people, indeed, who are not familiar with the leading British representatives of the sub-family *Poly-podieæ*. It is difficult, indeed, to make a journey in any part of the country without sooner or later coming across some plants of the Common Polypody. Some other species of the genus *Polypodium* are not uncommon in certain parts of the country.

Polypodium vulgare. Here the generic name is derived from two Greek words—*polys*, “many,” and *pous*, “a foot.” This has been given to the plant on account of the fact that the creeping and branching rhizomes from which the fronds arise are in some way suggestive of feet. The specific name, of course, means “common.” The Common Polypody.

This species has a creeping root-stock which in its young days is covered with brown scales. From the underside there grow masses of fibrous roots, which often spread for a considerable distance. The rhizome may be very much branched, and from it alternately on either side arise the fronds. These may be quite short—about five or six inches—or, on the other hand, they may be as much as one or two feet in length. The stipes is usually about the same

length as the leafy portion of the frond and is of a plain green colour. The general outline of the leafy part of the frond is lanceolate, tapering to a point, broad in the centre and narrowing slightly at the base. The frond of the Common

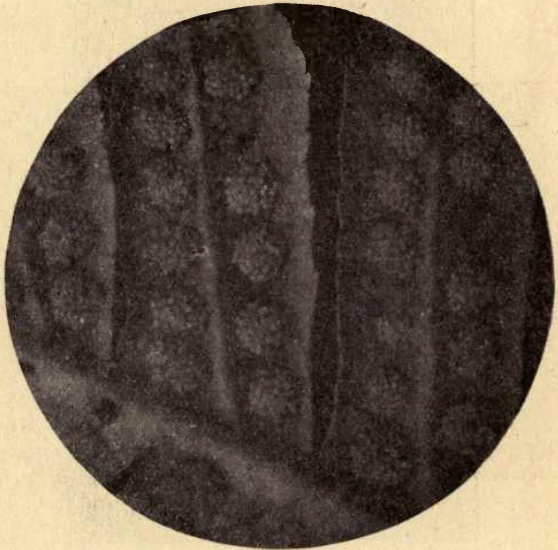


Polypodium vulgare. The Common Polypody.

Polypody is cut in a pinnatifid manner. The lobes, which are more or less rounded at the tip, are separated by openings in which the leafy portion is cut almost down to the rachis. Now and again the margin of the lobes is somewhat toothed.

On the back of the frond are to be found the

sori. These are disposed on both sides of the mid-ribs of the lobes ; they are circular in shape and have no indusia or covering of any kind. When the sporangia are young the sori are of a very pale yellow colour ; this changes to a rich golden-brown as the capsules mature. The sori



Enlargement of the sori on the frond of Common Polypody.

are mostly confined to the upper portion of the frond, and on account of their bright colouring add very much to the appearance of the leaf. There are a large number of varieties of the Common Polypody.

The Common Polypody will, of course, grow in almost any position. It often finds a home

amongst the branches of old oak trees, whilst it seems to be equally happy on the wall or the hedge-bank. It is of fairly easy culture in the garden, though the plant likes a well-drained situation. The Common Polypody is an ever-green species.

Polypodium phegopteris. Here the specific name is formed of two Greek words—*phegos*, "a beech," and *pteris*, "a fern." This is, of



Polypodium phegopteris. The Beech Fern.

course, a rendering of the popular name, though why the species has been called the Beech Fern nobody seems to know. Certainly the species is not like a Beech, neither can it be said to grow in association with this tree. The Beech Fern or Mountain Polypody.

This species has a slender creeping rhizome from which arise the dainty light green fronds. The fronds vary from about six inches to a foot in length; the stipes is longer than the leafy

portion, and is of a light green colour. The outline of the leafy part is triangular in form, and on either side of the rachis are the tapering pinnæ. At the top the frond is pinnatifid, whilst the lower pinnæ are deeply cut. A very distinctive feature of the Beech Fern is the way in which the lower pair of pinnæ point downwards away from the tip of the frond.

Nearly the whole of the underside of the frond bears the sori. These are placed quite near to the margins of the lobes of the pinnæ. Like all the Polypodies the clusters of sporangia have no indusia.

The Beech Fern cannot be called a common species, though it is often abundant in certain localities. It is much more frequent in Scotland than elsewhere, and may be looked for hopefully in almost any moist wood. It also occurs abundantly in some parts of the North of England. Unless the Beech Fern can be given a moist position it is not an easy plant to grow in the open garden. It is, however, successfully cultivated in the greenhouse. The plant dies down in the winter, and the new fronds do not appear until somewhat late in the spring.

Polypodium dryopteris. Here the specific name is derived from two Greek words—*drus*, "an oak," and *ptēris*, "a fern." Here again it is not easy to see a resemblance between this fern and an oak, unless it be that the newly-developing fronds are in colour something like the delicate green of the tree when it is decked in its new foliage. The Oak Fern or Three-branched Polypody.

This plant has a thin creeping rhizome from which the fronds arise. The stipes is of a pale green colour, and it is usually longer than the leafy portion. Actually the frond is divided

into three branches, each of which is triangular in shape and pinnate towards the base, becoming pinnatifid at the tip. The pinnæ are deeply segmented. The unrolling of the frond is a very novel feature of this Fern, each branch at this time appearing to be like a small coil of wire. In its early days the golden green colour of the frond is very much pronounced, but as the leaf ages a deeper tone is assumed.

The sori are disposed near to the margins of the lobes of the leaves, and these are circular and without indusia. The lower pinnæ of the Oak Fern do not point downwards, as is seen in the case of the Beech Fern.

The Oak Fern is common in many parts of Scotland, and is to be seen carpeting the ground of many a moist wood. It also occurs in England chiefly in the northern counties. In some parts of Wales it is to be found in plenty, but the species is said to be rare in Ireland. The Oak Fern grows in a damp and shady spot in the garden, though it is often more happy in a pot. The fronds of the plant die down in winter, and the fresh ones do not start until late in the spring.

In some books a species called *Polypodium calcareum* (The Limestone Polypody) is described. In some quarters this plant is regarded as a variety of *P. dryopteris*, as it is similar in some respects. Mr. C. T. Druery considers it to be a distinct species. The chief points of difference are said to be the following. The whole plant is larger in growth, whilst the green of the fronds is not such a golden colour, even in the early days. Also the pinnæ are not arranged so definitely in the form of three branches, as is to be observed in the case of the Oak Fern. Finally, the unrolling of the frond does not present the

appearance of three little balls, seeing that each pinnæ unfolds separately. The Limestone Polypody occurs chiefly in the North of England.

Polypodium alpestre. The Alpine Polypody. This is a most remarkable species, in that it bears a singular resemblance to the Lady Fern. By some authorities it is positively regarded as a Mountain form of the Lady Fern. The reason for linking the species with the Polypodies is found in the rounded sori, which have no indusia. The Alpine Polypody has a short tufted root-stock, and from this arise the fronds, which may be a foot or even more in height. The stipes is very short when compared with the leafy portion, and it is covered with brown scales. The general outline of the fronds is broadly lanceolate, and they are twice divided. The pinnæ are arranged in alternation on either side of the rachis, and these are divided into pinnules with blunt points. The pinnules have toothed edges. the sori are chiefly situated near to the inside border of the pinnules. Those who consider that the Alpine Polypody is a form of the Lady Fern call the species *Pseudathyrium alpestre*.

The Alpine Polypody seems to be exclusively confined, as far as the United Kingdom is concerned, to the highlands of Scotland. It is sometimes to be found at an altitude of four thousand feet above sea-level. In spite of its restricted locality the Alpine Polypody is an easy subject for the garden, if it can be provided with a well-drained situation.

CHAPTER IX

THE ROYAL FERN

UNDER the name of the Flowering Fern it is probable that most people are familiar with the subject we are now about to consider. The title has without a doubt arisen from the fact that the species bears its sori in masses at the termination of the fronds, quite apart from the leafy portion. The Royal Fern is the sole British representative of the family Osmundaceæ.

Osmunda regalis. There is great diversity of opinion upon the derivation of the name Osmunda. The name is thought to be of Saxon origin, and possibly was given to the Fern in honour of a personage who bore the name of Osmund. Osmunda was one of the titles of the great god Thor. In other quarters the name is said to be compounded of the two words *os*, "a house," and *mund*, "peace." Finally, a pretty story associates the name Osmunda with a certain Osmund, a ferryman, who, to hide his daughter from marauding Danes, placed her amongst the great clumps of the Royal Fern which grew so plentifully by the riverside. The specific name *regalis* is simply Latin for "royal," and is an apt reference to the noble proportions of this Fern.

The Royal Fern has a sturdy tufted root-stock which in an old example may well be one or two feet in height. From the crown of the

root-stock arise the fronds, which are of a yellow-green colour when they are young. The



Osmundia regalis. The Royal Fern.

stipes is about the same length as the leafy portion, and the fronds themselves often rise to a great height. Cases are on record where; the

plant being in a very damp situation, the fronds have been as much as twelve feet in height. Average specimens would range from three to six feet. The fronds are twice pinnate, the pinnules being oblong with uncut edges. Some of the fronds are barren and never bear any sori.

In the case of the fertile fronds only the upper portion produces the clusters of spore cases. Here the leafy portion of the pinnules is very much contracted, so that little or no green is visible. The sori are quite naked, no indusia being present at any time. A notable feature of the sporangia is that they split up into two valves when about to burst, and are not provided with the elastic ring (*annulus*) which assists in the rupture of the capsules in the case of most ferns. That the pinnules which bear the sori are exactly comparable to the leafy portion is often very plain. Here and there on a plant it is possible to find fertile examples which have developed partly in a barren, and partly in a fertile manner.

The Royal Fern is essentially a plant of the marshland. It never grows happily in dry or elevated situations. It is perhaps to be found at its best growing by the side of some river or stream. The Royal Fern has been found in many parts of the United Kingdom, though the plant suffers much from the depredations of trippers. Most fern-lovers know of places where this handsome species grows in abundance, but they wisely keep such knowledge to themselves. In the garden the Royal Fern grows well, but it must not suffer from lack of water, or it will prove but a poor subject. The fronds of the Royal Fern die down at the coming of the frost, and the young growth does not put in an appearance until the late spring.

CHAPTER X

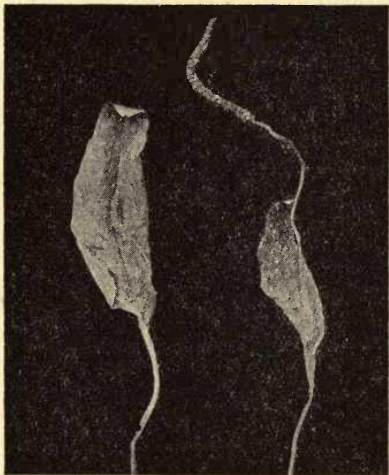
FOUR CURIOUS FERNS

THE three species which must now be described would hardly be recognized as Ferns at all by most people. It has been indicated in an earlier chapter that there is really some doubt as to their true position, but for the sake of convenience they are here included amongst the Ferns. All the British species of the family Ophioglosseæ are somewhat inconspicuous plants, owing to their habit of growing mixed up with a lot of herbage.

Ophioglossum vulgatum. The generic name is formed of two Greek words—*ophios*, “a snake,” and *glossa*, “a tongue”; a reference to the fact that the barren leaf was thought to bear a resemblance to a snake’s tongue, though it must be confessed that the likeness is not very apparent. The word “vulgatum” is, of course, Latin for “common.” The Common Adder’s Tongue.

In this species the frond is very definitely divided into two parts, a leafy portion and a spike. These are borne on a stalk about six inches in length which arises from a fleshy root-stock. The roots of the Common Adder’s Tongue are quite coarse and entirely unlike the wiry roots of the majority of ferns. The leafy or barren portion of this curious frond is not

divided in any way and is roughly egg-shaped. The fertile portion is in the form of a stalked spike, the spore cases being arranged on either side in double rows. The capsules are rounded in form and have no elastic ring, but open transversely when the contents are ripe. Attention should be called to the beautiful



Ophioglossum vulgatum. The Adder's Tongue.

veining of the barren leaf of the Common Adder's Tongue, which forms a perfect network through the green tissue.

The Common Adder's Tongue is really very abundant in many parts of England. It should be looked for in damp meadows, and will probably be difficult to find without a close search. It is not so abundant in Scotland and Ireland.

The only way to secure the plant safely for cultivation is to cut up a piece of turf, and remove the whole thing into a position where the soil is moist and rich. The Common Adder's Tongue is not very often cultivated, as from the gardener's point of view its decorative value is small. The new frond of the Common Adder's Tongue is fully developed by June, and it disappears early in the autumn.

Ophioglossum lusitanicum. Here the specific name is taken from Lusitania, the old designation of Portugal—a reference to the fact that the species is abundant in that country, as indeed it is in other parts of Southern Europe. The Little Adder's Tongue.

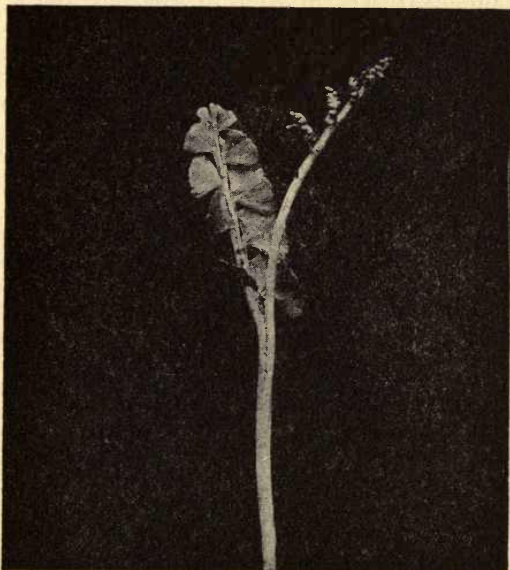
This plant is really a miniature addition of the former species. There is no doubt, however, that it is to be regarded as a distinct type, although at one time it was thought to be merely a variety of *O. vulgatum*.

As far as the United Kingdom is concerned the Little Adder's Tongue has only been discovered in one or two localities. Some years ago it was stated to have been found in Cornwall, and it certainly used to occur in Guernsey.

Botrychium lunaria. The generic name in this case comes from a Greek word which means "a cluster," this being a reference to the packed sori of the fertile pinnæ. The specific name comes from the Latin *luna*, "the moon,"—an allusion to the curiously-shaped pinnæ on the barren part of the frond. The Moonwort.

This is an interesting species which is easily distinguished from the Adder's Tongue. The plant has a fleshy root-stock from which arises a frond divided into two parts, a leafy portion and a fertile branch. The whole frond is about six or eight inches in height, and the stipes is

usually more than half the entire measurement. The leafy branch is pinnate, and its divisions are curious crescent-shaped processes which may be toothed round the edges. These are usually rather crowded together on the stem. The



Botrychium lunaria. The Moonwort.

fertile portion of the frond is very upright, and bears about the same number of branches to be counted on the leafy portion. These branches are again divided into sections which bear the clusters of spore cases. These are of a reddish-brown colour and burst open when the contents are mature, in the same manner as that to be

seen in the Adder's Tongue. In the Moonwort, as in the previous species, it is possible to find the next year's frond concealed at the apex of the root-stock.

The Moonwort grows in drier situations than that which suits the Adder's Tongue. It is abundant in many parts of England, and is a very common plant in localities in Yorkshire. The species also occurs in other parts of the United Kingdom, though on account of its habit of growing mixed up with grass, the Moonwort is often overlooked.

The following is the only indigenous species related to the Gold and Silver Ferns of our greenhouses :—

Gymnogramma leptophylla. The generic name is derived from two Greek words — *gymnos*, "naked," and *gramme*, "a line"; an allusion to the unprotected sporangia. The specific name means "slender leaf." The Annual Maidenhair.

This is a pretty little species with barren and fertile fronds of a bright green colour. In some respects the fronds resemble those of the true Maidenhair. The Annual Maidenhair only occurs in Jersey, as far as the United Kingdom is concerned.

CHAPTER XI

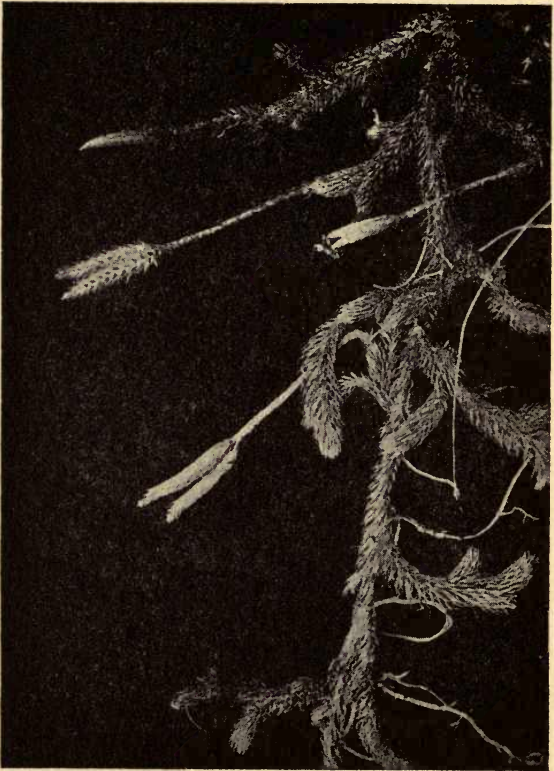
THE CLUB MOSSES

AS we have seen, the living species of the Club Mosses are comparatively insignificant plants. None the less, most of them are attractive each in its own way, and it is interesting to be able to identify the different kinds. First of all we may consider the five species of *Lycopodium*.

Lycopodium clavatum. Here the generic name is derived from two Greek words—*lukos*, “a wall,” and *pous*, “a foot.” One of the popular names of the plant is Wolf’s Claw; possibly an allusion to the curious branching-stem, although it must be confessed that the plant is not very claw-like. The specific name is derived from the Latin *clava*, “a club”; this having reference to the cones, or club, which bears the sporangia. The Stag’s Horn Moss, or the Common Club Moss.

This species has wiry stems of considerable length, sometimes measuring as much as six or eight feet. These run along close to the soil, to which they are attached at intervals by strong roots. The stems which branch in all directions are covered with small narrow leaves, each of which ends in a curious little bristle. This gives to the whole plant a singular grey appearance. These hair-like points to the leaves may

be regarded as a distinct feature of the Common Club Moss. In the autumn the fruiting spikes



Lycopodium clavatum. The Common Club Moss.

of the Common Club Moss are borne on the ends of erect stalks. The cones are generally about an inch in length, and at times as many as two

or three of them may be allotted to each stalk. If closely examined it will be found that the fruiting spikes are composed of a number of leaf-like bracts, each one of which bears the case filled with spores. After the dispersal of the spores the cones fall off, but the plant as a whole remains green throughout the winter.

The Common Club Moss is often very abundant upon the moors of the North of England, and also in Scotland and in Wales. On account of its creeping habit of growth the plant is often overlooked, and few people realize that this Club Moss is really very common. Sometimes single plants cover huge areas of ground, and many of the trailing stems are several feet in length. The spores of this, in common with those of other *Lycopodiums*, are inflammable; and in the old days these were used in the manufacture of fireworks.

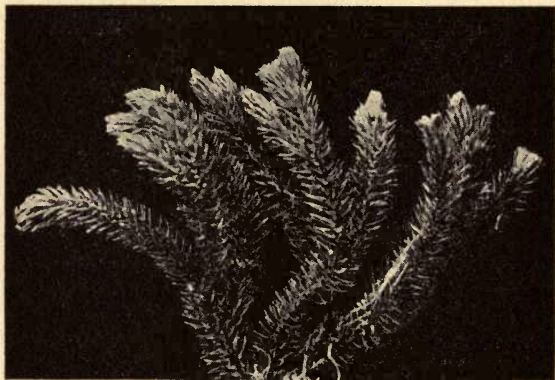
Lycopodium selago. In this case the specific name of *selago* was that formerly given to all the Club Mosses. The Fir Club Moss.

This is a very pretty little plant, which, on account of its upright habit of growth, attracts a good deal of attention. The stems vary from about three to six inches in height, and these rise upwards from a main stem which sometimes, but not always, trails along the ground for a short distance. The branches are very thickly covered with leaves which overlap one another, and are very stiff. Indeed, the whole plant is covered with the foliage, which, being narrow and pointed, is almost bristle-like in appearance. The colour of the foliage is bright green. The spore capsules are present in the axils of the uppermost leaves of the branches, and these are kidney-shaped. The Fir Club Moss is also very commonly propagated by means of special

little buds which appear at the tops of the branches. When these are developed they fall to the ground, and give rise to fresh plants.

The Fir Club Moss is probably almost as common as the Common Club Moss. It should, however, be looked for on elevated moors and the slopes of mountains.

Lycopodium inundatum. Here the specific name has reference to the fact that this Club



Lycopodium selago. The Fir Club Moss.

Moss grows in situations which are often under water. The Marsh Club Moss.

This is a peculiarly interesting species, in that it is the only British Club Moss to be found in lowland districts. The stems of the plants are prostrate, and these are so closely fixed to the soil with strong roots that it is almost impossible to remove a specimen without taking away the soil as well. The fertile branches rise in a very direct manner to the height of two or three inches, and these, like the main stems,

are thickly covered with narrow leaves, which have sharp points. The fructification is produced in the autumn, the capsules being borne between leaf-like scales at the upper part of the shoot. A singular thing about the Marsh Club Moss is that one end of the creeping stem is always decaying, and an individual plant is rarely more than a few inches in length. In the winter only the growing tip of the plant remains, and from this the whole of the new development arises.

The Marsh Club Moss is comparatively rare in the North of England, though in the South and West it is often to be found. As a rule it occurs in large isolated patches, and one may hunt for some distance around before finding any more specimens. It likes a thoroughly wet situation, and on this account is soon stamped out when any schemes of land drainage are undertaken.

Lycopodium alpinum. In this case the specific name is simply a reference to the fact that this Club Moss grows in mountainous districts. The Alpine Club Moss.

This species has long creeping stems which are rather bare of leaves. From these, however, spring the upright branches which are thickly covered with foliage; every one of the leaves terminates in a point. The Alpine Club Moss is an evergreen plant, and it is of a very bright green colour. The branches which bear the fertile spikes are somewhat taller than the barren ones, and these are often twice forked. The cone bears a number of thin scales, and between each of these and the stem is to be found the kidney-shaped capsules.

The Alpine Club Moss is often to be found

in great abundance in elevated districts in Scotland and Ireland. It seems to be most happy in elevated situations.

Lycopodium annotinum. In this case the specific name is from the Latin term signifying "a year old." This is an allusion to the fact that the yearly additions to the plant are very evident. The Interrupted Club Moss.

This species at first sight is sometimes taken for the Common Club Moss. It is, however, readily distinguished when its branches are examined; these are increased annually by an addition which is very plainly to be observed. It is seen that at these periods the leaves are smaller and much less inclined to spread than in the normal forms. At times the branches divide, and at the tip of some of the upright shoots occur the fertile cones. Each one of these is about an inch long, and it is covered with bracts upon which the spore capsules are borne. The Interrupted Club Moss is a fine species, and is of a pale green colour.

This is probably the rarest of our native Club Mosses. In some parts of Scotland it is said to be abundant, but the plant is always a local one. It has been found in the North of England, though it is decidedly uncommon.

In the United Kingdom there is only one native species of Selaginella.

Selaginella spinosa. In this case the generic name is derived from the name Selago; actually the name means "a little Club Moss." The specific name has reference to the tiny spines on the margins of the leaves. The Lesser Alpine Club Moss.

This plant is, of course, very distinct from the Lycopodium, in that it produces two kinds of spores. The Lesser Alpine Club Moss is a

small plant with both prostrate and upright stems. The leaves are very tiny, and owing to their semi-transparent nature the whole plant is of a pale green colour. Some of the upright stems are barren, but a certain proportion bear the spore capsules in the axils of the small leaves. In the upper part of the cone occur the capsules containing the microspores, whilst in the lower portion are to be found the sporangia, each of which produces three or four megaspores.

The Lesser Alpine Club Moss is probably more common than is generally supposed, especially in the North of England. It grows in damp situations and is often very much mixed up with other herbage, so that it is easily overlooked. It is now necessary to describe the two or three curious little plants which are closely related to the Ferns and Club Mosses.

Isoëtes lacustris. In this case the generic name originates in two Greek words—*isos*, "equal," and *etos*, "a year." This has reference to the fact that the plant keeps its leaves all through the year and does not alter in appearance. The specific name *lacustris* is derived from the Latin word *lacus*, a lake, and is an allusion to the fact that the plant grows in such a situation. The Quillwort.

This is an interesting little plant which is entirely aquatic in its habits. The Quillwort has a tuberous root-stock, and from this arise a large number of dark green leaves, somewhat resembling quills in shape. These are about three or four inches in length, and when the plant is growing in quantity in some pool, it is often taken for a kind of grass. At the base of the leaves, partly protected by the

sheathing, are to be found the spore capsules. These cases are of two kinds, those on the outermost rows of leaves containing the large spores, and those on the inner leaves being responsible for the small spores.



Isoetes lacustris. The Quillwort.

The Quillwort is often abundant in mountain lakes in Scotland and the North of England. Owing to its habit of growth, however, the plant is usually unnoticed by the majority of people.

Another species of Quillwort—*Isoetes Hystrix*—occurs in the Channel Islands, but it

has not been found elsewhere in the United Kingdom.

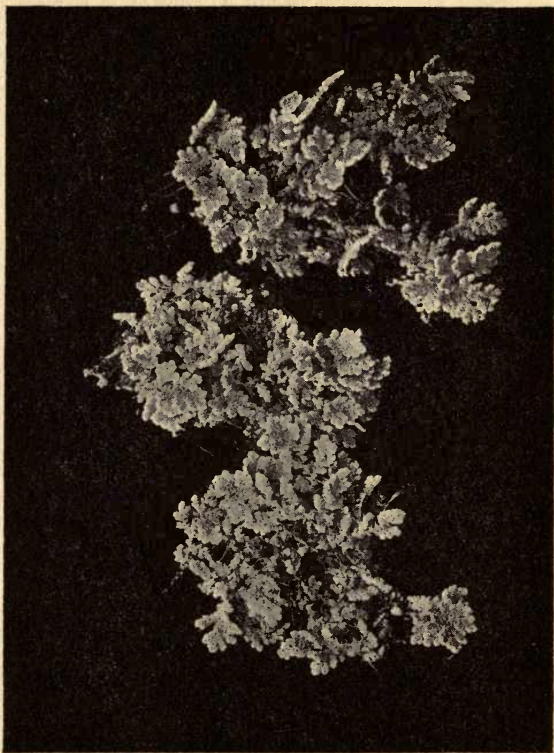
Pilularia globulifera. In this case the generic name is formed from the Latin word *pilula*, "a little pill," this being a reference to the curious pill-like spore capsules which the plant produces. The specific name of *globulifera* is made up from two Latin words—*globus*, "a ball," and *fero*, "I carry." This is another allusion to the rounded sporangia. The Pillwort.

This is a curious little plant with a very slender creeping root-stock. From this are sent down small tufts of roots into the damp soil in which the plant grows. From the upper part of the stem arise the leaves, which are bristle-shaped, two or three inches in length, and of an intensely bright green colour. It is interesting to note that in their young state these leaves uncoil very much in the same manner to be noticed in the Ferns. The spore cases are situated at the point where the leaf arises from the root-stock. Externally these are densely covered with brown hairs, and they are just about the size of a small pea. The sporangia are four-celled, and when the time for the dispersal of the spores arrive, the cases split open. The spores are of two kinds, and both sorts are present in the same sporangia. The large spores are confined to the lower portion of the case, the small ones to the upper part.

The Pillwort is common in some parts of England, though less so in Scotland and Ireland. It always grows in very damp situations, though it is rarely found submerged, save when this happens as the result of flooding. The Pillwort so often grows mixed up with

grass, which in some ways it resembles, that the plant is frequently overlooked.

Azolla caroliniana. Here the generic name



Azolla caroliniana.

is derived from two Greek words—*azo*, “to dry,” and *ollo*, “to kill”—an allusion to the fact that dryness is fatal to the well-being of

the plant. The specific name has reference to the fact that the plant is very abundant in Carolina, though as a matter of fact it occurs in other parts of the world. It should be pointed out that the *Azolla* is not a native of the United Kingdom, but it has become well established in some parts of the South of England.

During the summer time the *Azolla*, which is a floating plant, increases with great rapidity, sometimes completely covering the surface of a lake. At first the fronds, which are exquisitely beautiful, are of a silver-green colour; towards the autumn they assume a bright crimson tint. Underneath the fronds are produced a large quantity of roots which hang down into the water. Two kinds of spores are produced. The microspores are packed away in cases which are provided with curious barbed contrivances. The megaspores bear hooks, and in this way the two processes become attached. The *Azolla* is a pretty plant to grow in an aquarium, though where it has been able to make itself at home it will sometimes increase so vigorously that all other vegetation is killed.

CHAPTER XII

THE HORSETAILS

IT is now necessary to consider a very striking order of plants. Unlike the Club Mosses, it is probable that most people are familiar with one or more species of Horsetail; some of these plants are not only common, but they are also very striking in appearance. In all there are eight species of *Equisetum* which are natives of the United Kingdom, and most of these are fairly easy to identify if a few leading features are borne in mind.

Equisetum arvense. The generic name in this case is composed of two Latin words—*equus*, “a horse,” and *seta*, “a bristle.” Thus we see that the popular name of the plant is an almost exact translation of the scientific one. The specific name is derived from the Latin adjective *arvus*, “a field,” and has, of course, reference to the fact that the plant grows in pastures. The Field Horsetail.

This species is by far the commonest of all the Horsetails, and is very frequently to be found on embankments in fields and by the sides of roads. The plant, which dies down in the winter, starts its growth quite early in the year with the development of the fertile stems. These rise straight up from the branching root-stock, and are generally about five or six

inches in height. The stem, which is of a very pale colour, is of rather a succulent nature; it is hollow in the centre and in a certain way reminds one of bamboo. At intervals there are certain sheaths which are divided into a number



Barren stem of *Equisetum arvense*.

of teeth with very sharp points. The cone-like fructification is about an inch in length and bears a number of peltate scales to which the spore capsules are attached. The spores are ready for dispersal in the month of May. Just about this time the barren stems put in an appearance. These rise to the height of two

feet, or even more, and have many whorls of spreading branches which in their turn may again be branched. It is these branches which carry on the real vegetative work of the plant. For the real leaves we must examine the sheaths, which with their wedge-shaped teeth are to be found at the stem joints. The teeth are the only free portions of the leaves of the Horsetails. It is interesting to note that in each whorl the branches are equal to the number of leaves and are alternate to them. The stem of the barren branches of the Field Horsetail is slightly marked with furrows, which vary in number. The branches are usually only four-furrowed, and have sheaths with the same number of teeth.

The whole of the barren portion of the Field Horsetail is very rough to the touch. This is due to the fact that the plant is covered with tiny flinty particles. That the measure has a protective value is very evident, for cattle have hardly ever been known to eat the plant.

Equisetum maximum. In this case the specific name, of course, means great, and has reference to the fact that the species is the largest of all the kinds. In some old books this species is given as *E. Telmateia* and *E. fluvialis*. The Great Horsetail.

This is by far the most striking of all our native Horsetails. As a rule the plant grows in a damp situation, and it then assumes handsome proportions. The fertile stems appear on the scene about April, and these do not as a rule exceed a foot in height. They are very succulent, and have loose sheaths which have about thirty or forty teeth. The sheaths are green at the lower, and brown at the upper part, being distinctly marked with lines. The fertile

cones are three or four inches long and possess a very large number of scales. The barren stems are remarkable for their erect growth, and in a fine specimen these may be four or five feet in height. The stem bears numerous



Fertile cones of *Equisetum maximum*.

whorls of branches, and these branches may show yet further divisions. As a rule each whorl has thirty or forty branches apiece. On the upper part of the stem the whorls are very close together, but they are more widely separated at the lower portion. The main stems, which taper towards the apex, are

marked with lines, and at intervals are enclosed in sheaths; these have long teeth and fit the stem very closely. The branches are rough to the touch, and have sheaths which end in four or five teeth; each tooth in this case is prolonged into a bristle which has two toothed ribs. This is a feature by means of which it is always possible to distinguish the Great Horsetail from any other species. Now and again stems have been found which, whilst bearing fertile cones, at the same time branch in the manner to be observed in the case of the barren stems.

The Great Horsetail is widely distributed and is sometimes very abundant, though it is not so common as some of the other species of *Equisetum*.

Equisetum pratense. In this case the specific name is a Latin word which means "growing in a meadow." In some books this plant is known as *E. umbrosum*. The Shade or Blunt-topped Horsetail.

This species has three kinds of stems. The first of these is about six inches in height, and is provided with large loose sheaths. This bears the cone of fructification, which is ripened about the month of April. The second type of stem produces both branches and a fertile cone, though this latter is very much smaller than in the case of the first type of stem. Finally, there is the barren stem, which may be about eighteen inches in height; this is very rough, and has about twenty strongly-marked ridges. The sheaths, which are not so large as those of the fertile stem, fit somewhat closely. The stem branches freely, and it is to be noted that these branches have three or four ridges; as well, they bear sheaths which end in the same

number of teeth. A distinctive feature of the Shade Horsetail is that the topmost whorls of branches spread upwards in such a way that they reach the summit of the stem ; there is no long tapering point such as is to be seen in the case of the Field Horsetail, for instance. The result of this habit of growth is that the plant has a curious flat-topped appearance ; it is on this account that the species has received one of its popular names.

The Shade Horsetail grows in damp meadows and very shady woods, though it is not common in all districts.

Equisetum sylvaticum. In this case the specific name is taken from the Latin *silva*, "a wood," and is a reference to the habitat of the plant. The Wood Horsetail.

This is one of the most beautiful of our Horsetails. The plant has two kinds of stems, both of which are ultimately branched. The fertile stems put in an appearance first of all in the early spring ; at this time these bear only a cone and are without branches. With the dispersal of the spores the cone shrivels up, and then the stems starts to send out green branches. These branches give off whorls of smaller branches from their joints. In a general way the stems of the barren shoots are not so succulent as those which bear the cone ; the barren stems, too, are somewhat taller and branch more freely than the fertile ones. In both barren and fertile stems are to be noticed the whorls of small drooping branches which give a characteristic appearance to the Wood Horsetail, and by means of which it may always be identified. The sheaths which enclose the stem evidence three or four teeth, whilst the terminal branches (which are three-ribbed)

bear at each joint a sheath ending in three long pointed teeth. The stems of the Wood Horsetail are marked by about a dozen ridges.

The Wood Horsetail is often abundant in damp shady woods.

Equisetum palustre. The specific name *palustre* means "belonging to the marshes." The Marsh Horsetail.

This plant has a very thick rhizome from which arise the erect stems. The barren and the fertile stems closely resemble each other, being about a foot or more in height, with very rough surfaces on which it is possible to count from six to twelve very prominent ridges. The stems are enclosed at intervals in loose sheaths, which have the same number of teeth as the ridges on the stem. It should be noted that the branches from the various whorls show a marked tendency to turn upwards. On certain of the stems the fertile cone appears and the spores are ripened about June, after which the process withers. The plant as a whole remains green until late in the autumn. Sometimes in the case of large plants, cones have been known to occur on the tips of the branches of the Marsh Horsetail.

The Marsh Horsetail is a very common species, often growing in the greatest profusion by the sides of pools.

Equisetum limosum. In this case the specific name is a Latin word which means "full of mud"; this being an allusion to the fact that the plant favours swampy situations. The Smooth Naked Horsetail. The plant is also called the Water Horsetail.

A distinctive feature of this plant is that it has almost completely smooth stems, though a close examination will indicate the presence of a

number of slight ridges. The barren and the fertile stems are very similar, and in a favourable situation they will grow to the height of two or three feet. A curious feature of this plant is the irregular way in which the branches appear. Sometimes the stems are quite bare; on other occasions they are partly branched; in any case the branches are short. The sheaths with many teeth are closely pressed to the stem. The fertile stem is, of course, distinguished by the cone which it bears at the summit. It is said that cattle are not averse to eating the Smooth Naked Horsetail, and certainly the stems are not unpleasant to the touch.

The Smooth Naked Horsetail is a common plant, specially by the sides of streams and pools. It sometimes grows right in the water.

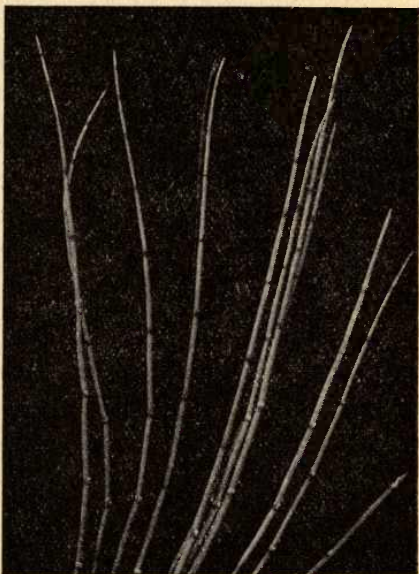
Equisetum variegatum. Here the specific name means variegated, and has reference to the fact that the sheaths enclosing the stem are pale green below and blackish in colour above. The Variegated Rough Horsetail.

As a rule this plant grows by the seashore, where, by means of its fibrous roots, it may play a useful part in helping to bind the shifting sand. The Variegated Horsetail is not exclusively maritime, however, for it sometimes grows by the sides of rivers and ponds. The barren and fertile stems closely resemble one another, and they are very nearly prostrate in habit. As a rule they are about a foot in height, and the stems have from four to ten ridges. The upper part of the stem is usually unbranched, but whorls of branches occur towards the base. The sheaths, which, as already stated, are green below and black above, fit very closely to the stem. The black teeth have white margins, and terminate in bristle-like points. The cones

are borne at the summit of the fertile stems, and are comparatively small.

The Variegated Rough Horsetail occurs chiefly, though not exclusively, in the North of England.

Equisetum hyemale.—In this case the specific



Equisetum hyemale. The Dutch Rush.

name is a Latin adjective which means "pertaining to winter," an allusion to the fact that the plant is to be found all through this season. The Rough Horsetail or Dutch Rush.

This is quite the most distinct of all the Horsetails. There are none of the whorled branches which are so familiar in the other

species, and it is only now and again that even a single branch is produced from the base of one of the sheaths. There is a strong resemblance between the barren and the fertile stems. These are both tall and very erect, usually running up to the height of two or three feet. The stem is very rough to the touch, and is marked with from fourteen to twenty ridges. The edges of these ridges are thickly covered with flinty particles. The sheaths of the Dutch Rush clasp the stem of the plant very closely. The fertile cone is small, and is placed at the top of the stem.

The Rough Horsetail is not a very common species, but is abundant on the Continent, especially in Holland and Germany, where it is largely employed for the fixing of the soil of embankments. The Rough Horsetail is very useful for polishing wood.

CHAPTER XIII

FERN COLLECTING AND PRESERVING

PERHAPS none of our native plants have suffered more from those vandals who root up every pretty thing they see than the Ferns. To the average tripper there seems to be something irresistible in the green fronds, and up comes the root, or enough of it to destroy the plant, and the prize is carried home. Even if the fern is so fortunate as to be planted at all, it is probably dealt with in such a way that its chances of living are very remote. County Councils may pass by-laws, but one is afraid that these will have little effect until there is amongst the people as a whole a more widespread regard for natural beauty. It is to be feared that one cannot entirely acquit the scientific student of helping in the destruction of Ferns. A rare find is a terrible temptation to the enthusiast, but if the plant is a solitary one it is a golden rule to leave it alone. Often enough a single frond will give us any quantity of ripe spores from which fresh plants may be raised. In any case the gathering of the leaf is a certain proof that one has found the particular species. If it is possible to re-visit the spot at a later date it is not unlikely that the specimen may have propagated itself in some way. Of course, where there are a number of

specimens there can be no harm in taking one for cultivation. The same applies to common Ferns, or varieties of these; and if by propagation the stock is increased the number of beautiful plants in the country is made the larger. So that there is a form of collecting which is perfectly legitimate, and, indeed, to be commended.

For those who start out on a Fern collecting expedition, one of the long narrow trowels will be found to be extremely useful. A proper vasculum is, of course, of service, but this is sometimes apt to get in the way, and it will not accommodate very large Ferns. Mr. C. T. Druery, who has done an enormous amount of Fern collecting at home and abroad, declares that he contents himself with some old newspapers and a ball of string. In this way bundles of the plants are easily made, and in most cases these can be readily carried about. Great care is necessary when removing the Ferns to do as little damage as possible to the roots. If it is desired that the plant should settle into its new home as quickly as possible, it is an excellent plan to take away with it a certain amount of soil. Of course, considerations of weight have to be taken into account, but the more mould round the roots the better. Never grasp a Fern plant from above and try to pull it away, as this will be almost sure to result in damage. Rock Ferns are often exceedingly difficult to remove, owing to the manner in which the roots of these plants spread to great distances in the crevices. Yet without a large amount of their roots these Ferns can never be satisfactorily established. In such cases a chisel and a mallet will often come in highly useful, as in

many instances if the rock is chipped away the Fern can be readily taken from its position. As the specimens are secured it is most important to take steps to protect them from withering. First of all, wrap a portion of damp newspaper round the roots, and then tie up with dry paper. When on a holiday the Ferns may be kept alive and in good condition for a week or so, if they are placed in some shady corner with their roots protected in the manner described. An occasional sprinkling of water will help to prevent any withering. Of course, for packing it is often necessary to cut off some of the largest fronds; and there is not much lost by so doing, for these often become very much damaged, and will probably die when the plant is established in its new quarters. The question is often asked at what time of the year may Ferns be removed. Nearly all our native species will suffer transplanting at almost any season if the business is carried out on the lines indicated. Of course, most specimens are probably taken up in the summer when the handsome foliage attracts the eye. In some ways this is the least satisfactory time on account of the hot dry weather, but by protecting the roots there is no reason why the specimens should flag to a harmful extent. Of course, newly acquired Ferns will pay for extra attention in the way of watering until they have secured a proper roothold.

A very interesting way of studying Ferns is that of collecting the fronds of the species which the hunter may come across. This is a pursuit to which no sort of objection can be taken, for, of course, the plant itself is not in any way disturbed, and is not in the least likely to suffer from having one or two of its

fronds removed. In a general way the fronds are best collected during the summer and autumn, when they will, of course, be well developed. It is much more difficult to secure perfect fronds than may be generally supposed, and even with the common species a number of plants may have to be examined ere specimens without blemish of some kind or another can be obtained. Seeing that the position and shape of the sori play such an important part in classification, the fronds should be secured when the patches of spore cases are developed. On the other hand, these should not be quite ripe, or they will be likely to burst in the process of drying, and the real character of the sori will not be very apparent. When they are gathered the fronds should be placed at once in a vasculum, or a long tin box, and must be kept there until the time for pressing arrives. Naturally it is a good plan to treat the fronds as soon as possible, though in a closed tin box they will keep for some days without withering.

If properly dried and pressed, it is possible to preserve the Fern fronds with a great deal of their natural colour. Botanical drying paper should be employed, and, of course, if desired an orthodox press may be used; but this is not really necessary. The cheapest plan is to secure two boards of wood of a size to cover the sheets of drying paper, which are placed between the boards. If the paper is about twelve by eighteen inches this will accommodate moderate examples of most of the fronds. Of course, special arrangements will have to be made for extremely large leaves. It is not a bad plan to have two straps with buckles so as to keep the boards

together, and prevent them from moving when the Fern fronds are in position. In the first place, two or three thicknesses of the paper should be spread on one of the boards. Now take the same number of sheets, and start to place these over the frond. Starting at the tip of the leaf the divisions should be carefully spread out in such a way that the frond as a whole is well displayed. To keep the frond in position it may be useful to put a book on the paper as it is spread out. A number of fronds may be accommodated between the two boards in this way, but it is important to have two or three pieces of the drying paper between each specimen. When all the fronds have been spread out in the manner indicated the uppermost board is put on the top of the layers of paper, and by means of the straps the pieces of wood are drawn together. A very small amount of pressure should be employed in the first instance, and a few light books on the topmost board will be all-sufficient.

After about twenty-four hours the fronds may be examined. They are still comparatively supple, and any misplaced pinnæ may be re-arranged without any difficulty. In any case, fresh pieces of drying paper must now be used, and on to these the fronds are placed. It will be found that as a whole they assume a flat position, and are very easily handled. A little stiff brush, or the end of a hairpin, will be found very useful at this stage to help in the working out of any refractory pinnæ. The pressing is carried out in the same manner as before, only if it is decided to make this the final stage of the process, the weights should be heavier. In the case of very com-

plicated fronds the process of examining may be repeated three, or even more times, with intervals of twenty-four hours. After two or three days it will be found that the fronds are quite dry, and they should have retained almost all of their natural colour.

The fronds may be moved into a portfolio formed of sheets of stoutish paper. They may be held in place by fastening a few strips of gummed paper over the stipes and rachis. The name, locality, and date of gathering should be added to each specimen. Of course, in all cases it is a good plan to have two fronds, one showing the upper and the other the under side. Where there are both barren and fertile fronds, an example of each should naturally be included. Thus, a highly interesting collection of fern fronds may be gathered together with a small amount of trouble.

One is often asked by those who wish to study British Ferns, where the most interesting specimens are to be found. The answer to the question is that it is always a wise plan to keep your eyes open wherever you go. Many of our smaller ferns are readily overlooked even by the keenest observers. The writer can call to mind an occasion when he sent away to a London nursery to buy an example of the Wall Rue Spleenwort. At the time he was living in a town, and without a long tramp into the country there seemed to be no hope of securing a specimen. A few days after the arrival of the purchased plant any quantity of the little Fern, in rather a dwarfed form, it is true, was found growing in the crevices of a wall adjoining a public road. The upper part of the wall being covered with ivy, the Spleenwort found a position beneath the protecting shade, where it attracted

no attention from the passers-by. Of course, certain species of Fern are extremely local, largely owing to the fact that they require special conditions of soil, etc. It is therefore quite useless to look for such in an average district. Many species flourish only in rock crevices or on old walls. Others are to be found, as a rule, in rather elevated positions, and we cannot hope to find them save in a mountainous country. Finally, there are a great many Ferns which can adapt themselves to a variety of conditions. The actual circumstances of their surroundings will make them vary more or less from the type, and this must always be borne in mind when specimens are being examined. In another way identification is sometimes rather difficult, owing to the fact that immature Ferns are often very misleading in their appearance. Quite likely they may resemble another species altogether. It is therefore only when a mature frond bearing sporangia is discovered that it is possible in some cases to speak with certainty. Many British Ferns evidence a marked tendency to "sport," and this is a fact which the beginner should always bear in mind. As a rule, however, even in the case of extreme varieties, a careful examination of the specimen will enable it to be identified.

CHAPTER XIV

THE CULTURE OF FERNS

IT goes without saying that Ferns of all kinds are interesting plants to grow in the garden and house. A few suggestions as to the culture of the various species described has been appended in each case, but one or two general remarks may not be out of place. First of all, it is desired to correct the popular impression that Ferns are happiest in very wet situations; true, these plants like plenty of moisture, but only one or two of the British species are ever found actually growing with their roots in water. On this account, great care should be taken to provide well-drained positions. The best kind of rockery should not be solid earth all through, and the plants will grow much better if there is a core of heaped stones covered with a deep layer of soil. Of course, shade is very desirable, and hardly any Ferns, even those kinds which grow on walls, are seen at their best in very sunny positions. Happily in most gardens it is possible to find a border with a northern aspect on which it is not easy to grow flowering plants with much success; in such a position Ferns will find a home that will suit them admirably.

Of course it is only the hardiest Ferns which can be expected to grow well in the town garden.

Many of the common, and strong-growing species, however, do very well anywhere, the only attention which they require being an occasional watering in dry summers. This will often save the foliage from drying up, a happening which makes the plants rather unsightly. Where the outside conditions are not very favourable, practically all the British species may be grown with ease under glass. In such conditions many kinds which do not flourish very freely in the open garden, grow into handsome specimens. A case in point is the Sea Spleenwort, which is an exceedingly difficult subject to establish out of doors, yet it grows well as a pot plant. Whatever the species, it is well to imitate the natural conditions as much as possible in the way of soil. For instance, the Limestone Polypody is not happy unless there is a certain amount of lime present in the soil. Ferns with upright root-stocks do well in ordinary pots, but those which produce creeping rhizomes are best accommodated in pans or baskets. One wonders why even some of the common British Ferns are not more generally cultivated in rooms. Small plants of the Lady Fern, for instance, make charming specimens, and in the comparatively dense shade of the apartment the fronds are unusually delicate in their form and colouring. In all forms of room culture the great enemy is the dust which settles so freely on the fronds, and the only way in which to combat this is through the agency of frequent syringings.

Fern cases were very much in vogue some years ago, and this is really a very delightful way of cultivating the plants. Of course, the old Wardian cases can often be picked up at second-hand shops, but one of the simplest

devices is formed with the aid of a cloche similar to those commonly used in French gardening. It is only necessary to have a zinc, or a galvanized tray on which to stand the glass in an inverted position. Some means or other should be devised for the drawing off of the superfluous water from the tray, and the simplest of all is to arrange a hole which can be stopped with a cork. Broken crocks should be strewn upon the tray, and on to this is heaped peaty soil mixed with sand. A few small rocks of some soft stone may be added, and in between these the Ferns are planted. Of course, the Filmy Ferns (*Hymenophyllum*) and the Bristle Ferns are good subjects, but many other species may be grown with great success in this way. The two chief dangers are a very rank growth, by means of which the stronger subjects overwhelm the less vigorous plants, and too much moisture. Where the dampness is excessive the fronds take on an unhealthy appearance, and mould may appear. The case should at such times be opened for a few hours each day to admit the drying air. The case may be kept in a light position, and when once under way it will rarely need any additional water.

A very interesting practice is the raising of young Ferns from spores. This is really a very simple undertaking, and almost always meets with success if the precaution is taken to sterilize the soil used by baking it in an oven. Afterwards it is, of course, necessary to moisten the mould, and the spores are then scattered on the surface. Keep closely covered with a bell glass and, in a few weeks, more or less, the baby Ferns will start to put in an appearance.

Those who take up the cultivation of British Ferns will certainly become interested in the

immense range of varieties which some species have produced. Not a few of these are extremely beautiful, and are well worth growing on this account, quite apart from their peculiarity.

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