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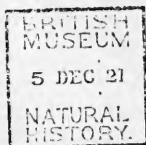
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PHANEROGAMS AND FERNS OF SOUTH ARDGOIL.

BY THOS. NISBET, M.A.

(*Read 8th November, 1910.*)

THE purpose of this paper is to place before the Society the botanical results of some recent observations on the distribution of the phanerogams and ferns of Ardgoil. The district to the north of Glencoe has been the subject of a valuable paper by Mr John R. Lee [Vol. III., p. 80—"The Flora of the Arrochar Mountains"], which includes the northern portion of Ardgoil. The following description deals with the peninsular part of South Ardgoil between Loch Goil and Loch Long, and defers for further work a description of the Brack and Ben Donich.

The statements made regarding the occurrence of plants are based on an extensive series of lists made mainly during numerous excursions in July and August of 1910. The frequency of occurrence of each plant is estimated from the number of times it occurs in the lists, and not from memory or impressions, which are apt to be misleading. The traverses made of the ground have included as far as possible repetitions of all the varieties of habitat at different elevations. In this way alone can prevailing features as well as local peculiarities be accurately ascertained.

The area dealt with is bounded on the north by Corrie Odhair and Coilessan Glen, on the west by Loch Goil, and on the east by Loch Long. It is triangular in shape, the northern base being about four miles from east to west, and the sides about five miles. The range of hills which bounds Loch Long is broken by Coilessan Glen, Allt Guanán, and the Pass of the Saddle into prominent blocks called The Brack (2580 feet), The Cnoc (2497 feet), Ben Reithe (2141 feet), and the Saddle (1704 feet). To the south-west of the Saddle, and separated from it by a stream and lochan, is a rugged ridge which culminates in Clach Bheinn (1433 feet). To the west of Ben Reithe the irregular ridge of Carn Glas (1648 feet)

connects with Tom nan Gamhna (1250 feet) and the Steeple Hill, immediately behind Lochgoilhead.

The whole of this area is strongly glaciated. Where the rounded bosses or *roches moutonnées* protrude there is little phanerogamic vegetation, but where the rocks have been subjected to weathering, or rock falls have produced broken rock, there is considerable variety of plant life.

The geographical features thus briefly indicated give rise to considerable diversity in the natural habitats of plants, which may be differentiated as follows:—

1. The shore strip up to high water of spring tides.
2. The shore margin above spring tides.
3. The low level roads, pathways, and cultivated ground.
4. The woodlands.
5. The hillsides above the woodlands dominated by bracken, heather, rush, or grass.
6. The allts—lower and upper.
7. Crags and summits.
8. The lochan.

SHORE STRIP.—The greater part of the shore belt consists of shelving rock or of stretches of beach with boulders. Near the mouths of the burns at Stuckbeg, Guanán, and Coilessan there are small delta formations with gravelly beaches, and where the River Goil enters Loch Goil a gently shelving shore of sand and mud has been formed similar to that at the head of all the sea lochs. The prevailing plants of the rocky strip are *Armeria vulgaris* and *Plantago maritima*, and of the gravel stretches *Potentilla anserina*. At Lochgoilhead the low tide level is marked by small fields of *Zostera marina*, var. *angustifolia*, and the high tide level by a sward of salt grass. Of the latter the main constituents are *Glyceria maritima*, *Plantago maritima*, *Glaux maritima*, *Armeria vulgaris*, *Cochlearia officinalis*, *Triglochin maritimum*, *Juncus Gerardi*, *Aster Tripolium*, and *Festuca duriuscula*.

Near the mouth of the River Goil is a level part known as the Glebe, and marked on the Ordnance Survey map as the Saltings. It is level, occasionally flooded by very high tides and crossed by winding depressions, which mark old courses of the river. Salt water occasionally flows up these depressions, which show a strong development of *Scirpus maritimus* and *Triglochin maritimum*. The upper parts of the sward

consist of varied associations, but the lower parts are almost entirely composed of *Plantago maritima*, *Armeria vulgaris*, *Glaux maritima*, *Juncus Gerardi*, *Aster Tripolium*, and *Agrostis alba*, var. *maritima*. The presence of the last named and the absence of *Glyceria maritima* differentiates this sward from the salt grass near the shore. Parts of this turf have been cut for the local bowling green, and on the bare earth exposed *Plantago maritima* is markedly and almost solely re-establishing itself.

SHORE MARGIN.—The shore margin above high tide levels affords shelter to a different series of plants. In hollows of the banks and between rocks are collections of alluvium and humus, and occasionally a narrow fringe of a similar soil extends for a short distance. On the land side these are usually more or less sheltered by trees. The commonest plant here is *Scutellaria galericulata*. *Circea lutetiana* is also prevalent, and *Lycopus europæus* is common. The first and last named occur all round the coast. The plants limited locally to this shore strip are:—

<i>Prunus spinosa</i> .	<i>Scutellaria galericulata</i> .
<i>Oenanthe crocata</i> .	<i>Lycopus europæus</i> .
<i>Artemisia</i> ——— ?	<i>Rumex crispus</i> .
<i>Calystegia sepium</i> .	<i>Polygonum Persicaria</i> .
<i>Solanum Dulcamara</i> .	<i>Agropyrum repens</i> .

ROADS.—Roads are limited to about one and a half miles along the shore from Lochgoilhead, and a few short intersecting roads in the village. The following plants have up to the present been observed only along roadsides, on roadside walls, or in adjoining ditches:—

<i>Corydalis claviculata</i> .	<i>Arctium Lappa</i> .
<i>Geranium pratense</i> .	<i>Veronica arvensis</i> .
<i>Geranium molle</i> .	<i>Scleranthus annuus</i> .
<i>Trifolium procumbens</i> .	<i>Polygonum Aviculare</i> .
<i>Trifolium minus</i> .	<i>Polygonum Hydropiper</i> .
<i>Epilobium tetragonum</i> .	<i>Juncus tenuis</i> .
<i>Galium uliginosum</i> .	<i>Carex remota</i> .
<i>Achillea Millefolium</i> .	<i>Phleum pratense</i> .
<i>Senecio vulgaris</i> .	

WOODLAND.—The lower slopes of the hills all round the peninsula are covered by a belt of woodland interrupted by considerable gaps at Lochgoilhead, Stuckbeg, Corran, Mark,

and Coileasan. This belt extends up the hill slopes for varying distances, but generally from four hundred to six hundred feet, and sends tongues of woodland up the banks of the streams to about one thousand feet, a height reached usually by the birches. This woodland belt consists mainly of birch and oak, the oak occasionally being predominant, but usually the birch, and mixed with these are frequent isolated hazel, hawthorn, alder, holly, ash and rowan. The greater part of the wood consists of trees about fifty years old, with occasional older trees here and there, especially holly and hawthorn.

On the slopes of Corran Bay there is a strong development of alder, the birch disappearing, so that the wood consists of alder, oak and hawthorn. Where birch and oak dominate, as is generally the case all round the coast, the shade of these trees is slight, so that bright light penetrates to the ground; but where hazel and alder dominate, as is the case only in this half-mile, the shade is dense and the ground flora is different. The type plant of the birch and oak wood is the bracken, and that of the hazel and alder the mountain shield fern—the bracken being a light-loving fern, whereas the mountain shield fern must have almost continuous shade. These two types are accompanied by other characteristics. The dense shade of the one allows usually only a sparse vegetation, the loose, moist earth in many places being almost bare, whereas the open canopy of the other favours a more plentiful growth. The following are three lists from the oak wood, each for a small area:—

- | | |
|---------------------------------|------------------------------|
| 1. <i>Pteris aquilina</i> . | 2. <i>Pteris aquilina</i> . |
| <i>Aspidium Oreopteris</i> . | <i>Oxalis Acetosella</i> . |
| <i>Blechnum boreale</i> . | <i>Lysimachia nemorum</i> . |
| <i>Potentilla Tormentilla</i> . | <i>Circæa lutetiana</i> . |
| <i>Oxalis Acetosella</i> . | <i>Primula vulgaris</i> . |
| <i>Teucrium Scorodonia</i> . | <i>Agraphis nutans</i> . |
| | <i>Aspidium Oreopteris</i> . |
| 3. <i>Pteris aquilina</i> . | |
| <i>Aspidium Oreopteris</i> . | |
| <i>Galium saxatile</i> . | |
| <i>Oxalis Acetosella</i> . | |
| <i>Agraphis nutans</i> . | |
| <i>Anthoxanthum odoratum</i> . | |



FIG. 1.

Birch and oak wood near Dail, Loch Long, with bracken area in foreground. Altitude 300 feet. Looking north.



FIG. 2.

[T. Nisbet.

Alder and hazel wood near Lochgoilhead, with shade development of mountain shield fern (*Lastrca Oreopteris*). Altitude 200 feet. Looking south.

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The following are two lists from the alder-hazel wood :—

- | | |
|---------------------------------------|---------------------------------|
| 1. <i>Aspidium Oreopteris</i> . | 2. <i>Aspidium Oreopteris</i> . |
| <i>Oxalis Acetosella</i> . | <i>Ranunculus repens</i> . |
| Mosses, with scattered
plants of:— | <i>Mercurialis perennis</i> . |
| <i>Galium saxatile</i> . | <i>Allium ursinum</i> . |
| <i>Primula vulgaris</i> . | <i>Lysimachia nemorum</i> . |
| <i>Agrostis</i> ———? | <i>Primula vulgaris</i> . |
| <i>Potentilla Tormentilla</i> . | |
| <i>Viola sylvatica</i> . | |

In the alder-hazel wood group (1) asserts itself over the drier parts of the wood floor, group (2) over the moister. Even in the alder-hazel wood, wherever the grouping or the spacing of the trees permits the ingress of sufficient light, the bracken at once springs into dominance. It would appear from this phenomenon that the companionship of bracken and birch is dependent on light rather than soil.

BRACKEN.—Outside the woodlands a striking feature is the strong development of bracken over the open hillsides. While the tops of knolls and crags may often be crested with heather or covered with grass, the sides of the hills are almost invariably clothed with bracken up to an altitude of about eight hundred feet. At low levels the flatter wet parts are usually occupied by tracts of bog myrtle, and at higher levels by rushes, which also dominate the wet slopes, so that the appearance is that of a mosaic of bracken, myrtle, rush, grass, heather, and lichen-covered rock. Above eight hundred feet the development of the bracken weakens in the exposed parts, but still remains strong in the sheltered hollows up to about eleven hundred feet, where the bracken completely ceases. The shade afforded by the bracken naturally causes an association of shade loving, or shade tolerating, plants to spring up. At one place, at two hundred feet, the association was:—

- | | |
|------------------------------|---------------------------------|
| Bracken (dominant). | <i>Veronica officinalis</i> . |
| <i>Aspidium Oreopteris</i> . | <i>Potentilla Tormentilla</i> . |
| <i>Blechnum boreale</i> . | <i>Galium saxatile</i> . |
| <i>Oxalis Acetosella</i> . | <i>Linum catharticum</i> . |
| <i>Ranunculus acris</i> . | |

RUSH.—From sea-level upwards, but especially from about four hundred feet, that is, above the woodland strip, considerable tracts of the wetter parts of the hillside are covered with

beds of rushes. These rush beds have practically the same limits as the bracken, that is, up to eleven hundred feet, but they are often developed in tracts where the bracken will not grow. The dominating rush is *Juncus acutiflorus*, and the invariable associate is *Potentilla Tormentilla*.

A typical association from a bed at 1100 feet was:—

<i>Juncus acutiflorus</i> .	<i>Viola palustris</i> .
<i>Euphrasia officinalis</i> .	<i>Epilobium palustre</i> .
<i>Ranunculus acris</i> .	<i>Plantago lanceolata</i> .
<i>Potentilla Tormentilla</i> .	

An association at 450 feet, with rush strongly developed, was:—

<i>Juncus acutiflorus</i> .	<i>Holcus lanatus</i> .
<i>Potentilla Tormentilla</i> .	<i>Holcus mollis</i> .
<i>Viola palustris</i> .	<i>Sphagnum</i> .

An association at 450 feet, with rush weakly developed, was:—

<i>Juncus acutiflorus</i> .	<i>Molinia cærulea</i> .
<i>Carum verticillatum</i> .	<i>Galium saxatile</i> .

HEATHER.—In his paper on “The Flora of the Arrochar Mountains” (*vide* Vol. III., p. 107) Mr Lee notices the absence of true heather moors in that district. This absence is characteristic of the northern part of the area described in this paper, but southwards the ling, instead of remaining a subordinate constituent in the vegetation, becomes more and more social in its development. Over the Saddle and the hills to the south and west, as well as over some tracts on Ben Reithe, Carn Glas, and Tom nan Gamhna, the ling becomes dominant and covers considerable areas with heather moor. In Ardgoil the ling begins to fail in robustness about fifteen hundred feet, and ceases to be strikingly social in development about seventeen hundred feet, but occurs as a reduced occasional constituent up to nineteen hundred feet.

GRASS.—Above the bracken, rush, and heather areas extend the grass associations—using grass in its old and widest sense as applied to the complex green carpet—which comprise all sorts of plants associated with grass proper. These also extend down to sea-level, wherever they are not masked or ousted by bracken, rush, heather, or woodland. It follows from their great altitudinal range that they vary much in

complexity, and in the constituents which at various elevations and under various soil conditions become dominant.

The following list is from a small area of dry ground at 100 feet:—

<i>Anthoxanthum odoratum.</i>	<i>Galium saxatile.</i>
<i>Triodia decumbens.</i>	<i>Trifolium repens.</i>
<i>Nardus stricta.</i>	<i>Potentilla Tormentilla.</i>
<i>Agrostis vulgaris.</i>	<i>Calluna vulgaris.</i>
<i>Luzula campestris.</i>	<i>Cerastium viscosum.</i>
<i>Juncus squarrosus.</i>	<i>Carex</i> — (sp.).
<i>Aira præcox.</i>	<i>Moss</i> — (sp.).

The following list is from a small area of wet ground at 150 feet:—

<i>Molinia cærulea.</i>	<i>Drosera rotundifolia.</i>
<i>Ranunculus Flammula.</i>	<i>Scirpus cæspitosus.</i>
<i>Juncus communis.</i>	<i>Pedicularis palustris.</i>
<i>Eriophorum angustifolium.</i>	<i>Juncus supinus.</i>
<i>Narthecium ossifragum.</i>	<i>Sphagnum</i> — (sp.).
<i>Juncus acutiflorus.</i>	

From an analysis of many such lists at all elevations up to two thousand four hundred and seventy feet, *i.e.*, to the summit of Cnoc Coinnich, the following statements appear as generalisations:—

1. The majority of the common plants in the grass associations from one thousand up to eighteen hundred feet occur at low levels in dryish ground.

2. The majority of the plants in wet ground at low levels do not ascend.

3. The plants characteristic from eighteen hundred feet upwards are *Galium saxatile*, *Festuca ovina*, and *Vaccinium Myrtillus*. *Lycopodium selago*, *Vaccinium Vitis-Idæa*, *Campánula rotundifolia* and *Salix herbacea* occur (as sward plants) only above two thousand feet.

4. *Aira flexuosa* is common only in moorland tracts from one thousand to thirteen hundred feet.

5. *Vaccinium Myrtillus* appears as a grass constituent about one thousand feet, and remains common, as such, up to the summits.

6. *Nardus stricta*, common as an individual associate from sea-level to seventeen hundred feet, attains a moor-development in certain areas between one thousand and fifteen hundred feet.

7. Of the grass constituents each of the following, in different localities, becomes sufficiently dominant over others to form a moor of its own: *Molinia cærulea*, *Nardus stricta*, *Scirpus cæspitosus*, *Juncus squarrosus* and *Vaccinium Myrtillus*.

SUMMIT.—The summits of the hills have in most cases a plant association marked off from the flora a few feet below the summit. The following lists are given for all the principal summits, using summit as applicable to the few square feet, or square yards, which are under actual summit conditions of exposure.

THE SADDLE (1704 feet).

Lower Summit.

<i>Juncus squarrosus.</i>	}	In almost equal proportions.
<i>Empetrum nigrum.</i>		
<i>Calluna vulgaris.</i>		
<i>Vaccinium Myrtillus.</i>		
Moss		

Summit Ridge (slope to south-east).

<i>Calluna vulgaris.</i>	}	Dominants.	<i>Erica cinerea.</i>
<i>Empetrum nigrum.</i>			<i>Potentilla Tormentilla.</i>
<i>Nardus stricta.</i>			<i>Agrostis alba.</i>
<i>Juncus squarrosus.</i>			<i>Carex pilulifera.</i>

Summit.

<i>Calluna vulgaris.</i>	}	Dominants.	<i>Potentilla Tormentilla.</i>
<i>Juncus squarrosus.</i>			<i>Carex pilulifera.</i>
<i>Empetrum nigrum.</i>			<i>Carex</i> ——— (sp.).
<i>Vaccinium Myrtillus.</i>			Moss.
			<i>Luzula</i> ——— (sp.).
			<i>Nardus stricta.</i>
			<i>Galium saxatile</i> (little).

CNOG COINNICH (2497 feet).

Rhacomitrium lanuginosum.
Eriophorum vaginatum.
Vaccinium Myrtillus.

BEN REITHE (2141 feet)

South and Mid Summits.

<i>Rhacomitrium lanuginosum.</i>	}	Dominant.
<i>Vaccinium Vitis-Idæa.</i>		

With patches of *Juncus squarrosus*.

Luzula campestris.
Potentilla Tormentilla.
Vaccinium Myrtillus.
Galium saxatile.
Empetrum nigrum (a little).

North Summit.

As above, but with more *Vaccinium Myrtillus* mixed with the above two dominants.

CLACH BHEINN (1433 feet).

Rhacomitrium lanuginosum. *Calluna vulgaris*.

TOM NAN GAMHNA (1250 feet).

<i>Anthoxanthum odoratum</i> .	<i>Carex pilulifera</i> .
<i>Aira flexuosa</i> .	<i>Carex binervis</i> .
<i>Poa alpina</i> .	<i>Galium saxatile</i> .
<i>Festuca ovina</i> (vivip.).	<i>Potentilla Tormentilla</i> .
<i>Nardus stricta</i> .	<i>Vaccinium Myrtillus</i> .
<i>Juncus squarrosus</i> .	<i>Empetrum nigrum</i> .
<i>Luzula campestris</i> .	<i>Polytrichum</i> ——— (sp.).
<i>Scirpus cæspitosus</i> .	

ALLTS.—The following appear to be restricted to the allts, or nearly so:—

<i>Sanicula europæa</i> .	<i>Crepis paludosa</i> .
<i>Fragaria vesca</i> .	<i>Avena pubescens</i> .
<i>Rubus saxatilis</i> .	<i>Festuca sylvatica</i> .
<i>Geum urbanum</i> .	<i>Melica nutans</i> .

LOCHAN.—The following are confined to Corran Lochan:—

Equisetum limosum. *Nymphæa alba*.

The description of the distribution of each species which follows is intended to be applicable only to the area described at the beginning of the paper. A large addition of species and considerable modification in the statements will be necessary when Ben Donich and the northern section of Ardgool are included. No attempt is made to determine critically the forms of species belonging to *Hieracium*, *Salix*, and other difficult genera.

Alpine Rue (*Thalictrum alpinum*, Linn.)—In grass associations on Cnoc Coinnich, from 1500 up to 2100 feet on the rock ledges, where it fruits abundantly.

Anemone (*Anemone nemorosa*, Linn.)—Most frequently on the banks of the burns up to 1200 feet, in rock hollows up to 1800 feet; not noticed in the woods except near Coilessan.

Lesser Spearwort (*Ranunculus Flammula*, Linn.)—Very plentiful in ditches and wet places at a low level, and common on the hills, especially wherever water runs, up to 1750 feet. Where it occurs it is usually in much greater numbers than other buttercups.

Lesser Celandine (*Ranunculus Ficaria*, Linn.)—Bentham in the *Handbook* says: "Abundant in Britain, except perhaps the West Highlands of Scotland." Not once was it observed in summer excursions. A visit in May to Coilessan showed it to be a very common flower of the wetter parts; probably common at the lower levels.

Upright Meadow Buttercup (*Ranunculus acris*, Linn.)—Occurs very frequently along the roadsides and in fields, up the sides of all the burns, and is a common constituent of the rush association, but it is most striking when, from 1800 feet to 2100 feet, on the rock ledges of Cnoc Coinnich and Ben Reithe, it grows wherever earth has collected. It is absent from the woods.

Creeping Buttercup (*Ranunculus repens*, Linn.)—Common by roadsides in wet places; favours more shelter than *R. acris*; occurs frequently in the woods and in sheltered hollows up to 2100 feet. It does not occur in the rush associations.

Marsh Marigold (*Caltha palustris*, Linn.)—Occurs seldom in the burns up to 1750 feet on Cnoc Coinnich; the variety *minor* at 1650 feet.

Globe Flower (*Trollius europæus*, Linn.)—The only occurrence was on a rock ledge of Cnoc Coinnich at 2000 feet.

White Water-lily (*Nymphaea alba*, Linn.)—See Lochan (p. 9).

White Climbing Corydalis (*Corydalis claviculata*, DC.)—See Roads (p. 3).

Hairy Rock-cress (*Arabis hirsuta*, Br.)—Found on Ben Reithe in a rock hollow about 2000 feet, but not found elsewhere.

Cuckoo Flower (*Cardamine pratensis*, Linn.)—Common on the low ground, but not on the hills.

Hairy Bitter-cress (*Cardamine hirsuta*, Linn.)—Common on walls, in shady places in the allts, and occurs in rock hollows up to 1500 feet in Carn Glas.

Hedge-mustard (*Sisymbrium officinale*, Scop.)—By roadsides.

Scurvy-grass (*Cochlearia officinalis*, Linn.)—Is not common on the shore; observed only at the head of Loch Goil. Var. *alpina* occurs in rock hollows of Cnoc Coinnich (2000 feet), and at the head of Allt Guanán (1650 feet).

Shepherd's Purse (*Capsella Bursa—Pastoris*, Mœnch.)—By roadsides, on roadside walls, etc.

Marsh Violet (*Viola palustris*, Linn.)—Common over the whole district in wet places, from the shore margin up to 2000 feet.

Dog Violet (*Viola canina*, Sm.)—Common in drier habitats in rock hollows by the shore, on mountain rocks, and on banks to 1400 feet; apparently suffering more from altitude than *V. palustris*.

Milkwort (*Polygala vulgaris*, Linn.)—From low ground to 1750 feet. The blue form is commonest, the red next, and the white least; all forms occur up to 1000 feet.

Bladder Champion (*Silene inflata*, Sm.)—On the shore.

Ragged Robin (*Lychnis Flos-cuculi*, Linn.)—Occurs seldom, and not on the hills.

Corn-cockle (*Lychnis Githago*, Scop.)—In the corn-fields, but not every year.

Red Champion (*Lychnis diurna*, Sibth.)—Plentiful on the beach.

Pearl Wort (*Sagina procumbens*, Linn.)—Common on the shore rocks and shore margin, on walls, occasionally by the banks of streams, and in grass associations up to 1500 feet.

Mouse-ear Chickweed (*Cerastium viscosum*, Linn.)—No other variety of this variable chickweed has been noticed. This form is common by the roadsides, and is a constant constituent in the grass associations up to 1800 feet on Cnoc Coinnich.

Chickweed (*Stellaria media*, Cyrill.)—Frequent on low ground, and under overhanging rocks up to 1500 feet on Carn Glas.

Bog Stitchwort (*Stellaria uliginosa*, Murr.)—Frequent in the ditches on the low ground, and in wet places in the allts up to 600 feet.

Greater Stitchwort (*Stellaria Holostea*, Linn.)—Only on low ground, and plentiful in places.

Lesser Stitchwort (*Stellaria graminea*, Linn.)—By roadsides.

Water-blinks (*Montia fontana*, Linn.)—Wet places by roadsides and shore.

Tutsan (*Hypericum Androsæmum*, Linn.)—Frequently by the banks of streams up to 450 feet.

Trailing St. John's Wort (*Hypericum humifusum*, Linn.)—Observed only by the roadsides sparingly.

Shining St. John's Wort (*Hypericum pulchrum*, Linn.)—This is by far the commonest St. John's Wort. Occurs along the shore banks, by the roadsides, in the woods on banks, and on rocky ledges by streams up to 1600 feet on Ben Reithe.

Purging Flax (*Linum catharticum*, Linn.)—Common where it gets some shelter in ground not wet, as in grass associations, among bracken, and on the drier slopes of the allts up to 700 feet.

Wood Crane's Bill (*Geranium sylvaticum*, Linn.)—This adorns the drier banks and ledges of the allts from low levels up to 1750 feet, but is absent from the woods and mountain rock hollows.

Meadow Crane's Bill (*Geranium pratense*, Linn.)—Plentiful by roadsides at Lochgoilhead.

Dove's-foot Crane's Bill (*Geranium molle*, Linn.)—See Roadsides (p. 3).

Herb Robert (*Geranium Robertianum*, Linn.)—It seems to require shelter and avoids wet. This is the common geranium. It is one of the dominants in the vegetation sheltered by the shore bank, and is frequently met with at the retreating base of rocks up to 1100 feet on Clach Bheinn.

Wood Sorrel (*Oxalis Acetosella*, Linn.)—This is one of the most common plants from sea-level up to 2000 feet. It finds shade under banks, trees, bracken and rocks, and abounds where the ground is dry or moderately moist. It forms companionships with many different plants according to elevation.

Purple Clover (*Trifolium pratense*, Linn.)—Somewhat common by roadsides and in the fields, but only occasionally on the hills up to 600 feet.

White Clover (*Trifolium repens*, Linn.)—Common by the roads and in fields, and frequent on the banks of the allts up to 900 feet.

Hop Trefoil (*Trifolium procumbens*, Linn.), (*Trifolium minus*, Reth.)—By the roadside; neither form is common.

Bird's-foot Trefoil (*Lotus corniculatus*, Linn.)—Common on banks by the shore, the roadside, and on dry banks in rocky

parts in the allts; up to 1750 feet on Ben Reithe, the Garbh, and Cnoc Coinnich.

Greater Bird's-foot Trefoil (*Lotus major*, Scop.)—In wet places by the roadsides and in the fields, but on low ground only.

Tufted Vetch (*Vicia Cracca*, Linn.)—Occasional in fields on low ground.

Bush Vetch (*Vicia sepium*, Linn.)—Favours drier places than *Cracca*; occurring occasionally on low ground, and also up the burn courses on dry banks, where it is often found in conjunction with *Luzula sylvatica* and *Geranium sylvaticum*, as in a gorge from Cnoc Coinnich into Allt Guanán at 1500 feet.

Tuberous Bitter-vetchling (*Lathyrus macrorhizus*, Wimm.)—Occasional on lawns.

Meadow-sweet (*Spiræa ulmaria*, Linn.)—In wet places along the shore, by the roadsides, by ditches, and up the burn-sides to 1000 feet, but not on the hillsides nor in the woods.

Herb-bennet (*Geum urbanum*, Linn.)—Only once noticed in Allt Inverlounin.

Water-avens (*Geum rivale*, Linn.)—Frequenting the burn-sides, and occasionally in rocky hollows up to 2100 feet.

Raspberry (*Rubus Idaeus*, Linn.)—Occasional by the roadsides, seldom in the allts, but frequent on the Garbh, Cnoc Coinnich, from 1500 to 1750 feet.

Bramble (*Rubus fruticosus*, Linn.)—Observed at road levels only.

Stone Bramble (*Rubus saxatilis*, Linn.)—Not frequent. See Allts (p. 9).

Strawberry (*Fragaria vesca*, Linn.)—Occasional in allts.

Tormentil (*Potentilla Tormentilla*, Neck.)—This is probably the most widely spread flower; occurring in almost all kinds of habitat, from shore-side to summits of all the hills up to 2470 feet; occasionally absent from the very top.

Silverweed (*Potentilla Anserina*, Linn.)—By roadsides.

Lady's-mantle (*Alchemilla vulgaris*, Linn.)—Common from road-levels, especially by the sides of streams, on damp sloping banks, and ascends the hills to 2100 feet on Cnoc Coinnich.

Alpine Lady's-mantle (*Alchemilla alpina*, Linn.)—Begins to occur frequently about 1400 feet, and becomes prominent at 1750 feet. It descends the allts, particularly Allt Onich,

where it flowers as low as 100 feet. It does not occur on the summit of any of the hills, but ascends nearly to it. It appears to be absent south of the Pass of the Saddle, and quite common to the north of it. The presence of *Alchemilla alpina* by the side of a stream is a sure index (locally) that the headwaters are above 1750 feet.

Broad-leaved Willow-herb (*Epilobium montanum*, Linn.)—Common by the shore and the sides of the roads and burns up to 500 feet.

Square-stalked Willow-herb (*Epilobium tetragonum*, Linn.)—See Roadsides (p. 3).

Narrow-leaved Marsh Willow-herb (*Epilobium palustre*, Linn.)—Occasional in wet places by the roadside and on the hills, mainly among rushes up to 1100 feet. (*Epilobium alpinum*, Linn.)—On Cnoc Coinnich at 1800 feet.

Enchanter's Nightshade (*Circea lutetiana*, Linn.)—See Woodlands (p. 4).

Rose-root (*Sedum rhodiola*, Dc.)—Very common on rock faces from 1500 feet upwards; occurs in Eas Garbh as low as 450 feet. It has the same range as *Alchemilla alpina*, being plentiful to the north of the Pass of the Saddle, but absent to the south.

English Stone-crop (*Sedum Anglicum*, Huds.)—Frequent on rocks by the shore, and at low levels.

Purple Mountain-saxifrage (*Saxifraga oppositifolia*, Linn.)—Frequent over the higher rocks from about 1400 feet up to 1800 feet, and occasionally in the allts; in Eas Garbh at 450 feet; not to the south of the Pass of the Saddle.

Yellow Mountain-saxifrage (*Saxifraga aizoides*, Linn.)—From sea-level up to 1800 feet; most common above 1000 feet, but occurring in patches in the beds of the streams and in rocky hollows at all levels, including the shore, being the most common and widely distributed saxifrage.

Mossy Saxifrage (*Saxifraga hypnoides*, Linn.)—Only at high levels, 1500 to 2000 feet; the least common of the saxifrages, and only north of the Saddle.

Starry Saxifrage (*Saxifraga stellaris*, Linn.)—From 1000 to 1900 feet; most common above 1500 feet, but descending the allts to 350 feet in Allt Inverlounin; not south of the Saddle.

Alpine Clustered-saxifrage (*Saxifraga nivalis*, Linn.)—At 1800 feet on a ledge of Cnoc Coinnich.



Fig. 3.

Cnoc Coinnich, 2497 feet, with *Nardus* area in foreground. Crag (2000 feet) with talus, rich in alpine plants. Looking south-east.



FIG. 4.

Allt Onich, looking west. Altitude 450 feet. Site of afforestation by the Corporation of Glasgow.

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Golden Saxifrage (*Chrysosplenium oppositifolium*, Linn.)—Frequent at all levels from roadsides up to 2000 feet, where it is a beautiful object in wet hollows among rocks.

Grass of Parnassus (*Parnassia palustris*, Linn.)—Plentiful, especially in moist places among rushes, from sea-level up to 1900 feet, being best developed about 400 to 600 feet.

Round-leaved Sundew (*Drosera rotundifolia*, Linn.)—Common and widely distributed, especially on peaty ground, but not on pure peat; often on sphagnum. Does not rise apparently above a few hundred feet (no note of elevation).

English Sundew (*Drosera Anglica*, Huds.)—On a field, long out of cultivation, to north-east of Lochgoilhead, on the slope of the Steeple Hill.

Marsh Pennywort (*Hydrocotyle vulgaris*, Linn.)—Local and not common; only at low levels.

Wood-sanicle (*Sanicula europæa*, Linn.)—Common, especially in the wooded allts up to 600 feet.

Bishop-weed (*Egopodium Podagraria*, Linn.)—By roadsides.

Whorled Caraway (*Carum verticillatum*, Koch.)—By far the commonest of the umbellifers; occurring in great abundance on wet parts of the hillsides and on gently sloping banks of the allts. Its appearance among rushes indicates that the conditions of moisture are not sufficient for the best development of the rushes. It flourishes up to about 600 feet, where it ceases somewhat abruptly.

Water Dropwort (*Oenanthe crocata*, Linn.)—See Shore Margin (p. 3).

Angelica (*Angelica sylvestris*, Linn.)—Occurs occasionally along banks by the shore and by the roadsides; is common on the wooded banks of streams up to 1000 feet. It apparently does not occur in the woods.

Cow-parsnip (*Heracleum Sphondylium*, Linn.)—Occurs frequently along the shore-side, occasionally by roadsides, and up Allt Onich and Eas Garbh to 500 feet.

Wild Beaked-parsley (*Chærophylum sylvestre*, Linn.)—Only on the shore and in garden corners; not common.

Earth Nut (*Bunium flexuosum*, With.)—On grassy banks up to 750 feet.

Ivy (*Hedera Helix*, Linn.)—Common in the wooded parts, and also found adorning rock faces, rooted in clefts as high as 500 feet at least.

Honeysuckle (*Lonicera Periclymenum*, Linn.)—Common in the woods and wooded allts; also on the hills, where it trails over rock faces which are somewhat sheltered; up to 1000 feet.

Rough Marsh-bedstraw (*Galium uliginosum*, Linn.)—Occurs on low ground.

Water-bedstraw (*Galium palustre*, Linn.)—Occurs, but is not nearly as common as the variety *Witheringii*.

Rough Water-bedstraw (*Galium Witheringii*, Sm.)—Common along roadsides in ditches, and occasionally up the streams to 500 feet.

Cross-leaved Bedstraw (*Galium boreale*, Linn.)—Occasionally, from 750 to 1750 feet, where it is found on rock ledges. It does not appear to be frequent.

Robin Run-the-hedge (*Galium aparine*, Linn.) By roadsides, etc.

Smooth Heath-bedstraw (*Galium saxatile*, Linn.)—Next to Tormentil this is the most widely distributed flower, occurring almost everywhere in abundance, and ascending to the summits of the highest hills. It is absent from the shore-side, from the fields, and from the rush association where the rush is best developed, but present where the rush is more thinly developed.

Woodruff (*Asperula odorata*, Linn.)—Occasional in the wooded allts. Found under overhanging rock at 1100 feet on west face of Clach Bheinn.

Valerian (*Valeriana officinalis*, Linn.)—Common by the sides of streams up to 800 feet, and occasionally in wet places by the shore.

Devil's-bit Scabious (*Scabiosa succisa*, Linn.)—Common and widely distributed. In ascending it favours rock ledges where some soil supports mixed vegetation; in such places up to 1750 feet.

Seaside Starwort (*Aster Tripolium*, Linn.)—See Shore (p. 2).

Mountain Golden-rod (*Solidago cambrica*, Huds.)—This is one of the beautiful autumn flowers of the mountain rocks adorning the rock faces, from 1000 feet upwards, with its golden corymbs; ascending to 1750 feet. It is specially abundant on the quartzitic rocks to the south of the Saddle.

The Daisy (*Bellis perennis*, Linn.)—Occurs frequently by the roadsides, but not by the shore, and is absent from the

field flora. On the hills it occurs in patches at several places, especially on a dry slope on the south-east shoulder of Cnoc Coinnich at 1500 feet; in gorge of Sheckie burn, at 900 feet, with north exposure; on north-west face of Tom Molach at 850 feet; very occasionally in places on the hills if not overtopped by other vegetation. It is always in these habitats accompanied by *Prunella vulgaris* and *Euphrasia officinalis*.

Mountain Everlasting (*Antennaria dioica*, Br.)—Favours dry places on mountain rocks; occasionally found up to 1750 feet. In other places only where it has descended streams; at 200 feet in Allt Onich.

Ox-eye Daisy (*Chrysanthemum Leucanthemum*, Linn.)—By roadsides and in fields.

Mayweed (*Matricaria maritima*, Linn.)—On Carraig nan Ron (The Dog Rock).

Sneezewort (*Achillea Ptarmica*, Linn.)—Occasional from roadside habitats in moist ground, up sides of burns to 750 feet.

Yarrow (*Achillea Millefolium*, Linn.)—See Roadsides (p. 3).

Mugwort (*Artemisia* ———?)—An artemisia (species not determined) grows at the head of the loch between the sward and the road.

Coltsfoot (*Tussilago Farfara*, Linn.)—The distribution of this plant, so common in waste ground round Glasgow, is peculiar. It occurs frequently in stony places in the beds of streams up to 1000 feet, and occasionally by roadsides and shore. Otherwise the plant is not common.

Groundsel (*Senecio vulgaris*, Linn.)—See Roadsides (p. 3).

Ragwort (*Senecio Jacobæa*, Linn.)—By roadsides, shore margin, but not on the hills.

Burdock (*Arctium Lappa*, Linn.)—See Roadsides (p. 3).

Spear-thistle (*Cnicus lanceolatus*, Linn.)—Apparently rare; observed in two places only, the highest being 850 feet.

Marsh-thistle (*Cnicus palustris*, Linn.)—A frequent roadside plant in wet places, sometimes in the woods, and especially up the allts to 1000 feet.

Field-thistle (*Cnicus arvensis*, Curt.)—An occasional plant on dryish banks, by shore-side, in the woods, and on the hills to 850 feet.

Knapweed (*Centaurea nigra*, Linn.)—By roadsides, fields, etc., but not on the hills.

Autumnal Hawk-bit (*Apargia autumnalis*, Willd.)—Common in fields and on wettish slopes at low levels, and occasional to 800 feet.

Cat's Ear (*Hypochæris radicata*, Linn.)—The commonest and most widely spread of the composites, forming one of the dominants in fields at low levels and along the roads, but not on the shore side. It ascends the allts on wettish banks to 900 feet.

Dandelion (*Taraxacum Dens-leonis*, Desf.)—A frequent but not common roadside and hill plant at low levels, and occasional on the higher hills and rock hollows up to 1500 feet.

Smooth Hawk's-beard (*Crepis virens*, Linn.)—By roadsides and in fields.

Marsh Hawk's-beard (*Crepis paludosa*, Mœnch.)—One of the commonest, and, perhaps, the most ornamental flower of the rocky and wooded allts up to 1000 feet, being specially prominent within reach of the spray of cascades, and never well developed away from streams.

Mouse-ear Hawkweed (*Hieracium pilosella*, Linn.)—Occasional on dry rocks, or on dry banks up to 1000 feet.

Wood Hawkweed (*Hieracium sylvaticum*, Sm.) Wall Hawkweed (*Hieracium murorum*, Linn.)—This plant in its multifarious varieties is common on rocky places, from road levels up to 1750 feet. It is often a beautiful adornment of the rocky banks of the higher course of streams. Forms not meanwhile differentiated.

Alpine Hawkweed (*Hieracium alpinum*, Linn., probably *nigrescens*, Willd.)—On Carn Glas, at 1450 feet, on a rock face.

Broad-leaved Hawkweed (*Hieracium boreale*, Fr.)—Hawkweeds of this form are occasional on low ground along the shore banks, and on banks by the roadside.

Nipplewort (*Lapsana communis*, Linn.)—By roadsides.

Water Lobelia (*Lobelia Dortmanna*, Linn.)—In Corran Lochan.

Harebell (*Campanula rotundifolia*, Linn.)—Occasional, but not common at low levels; not occurring by roadsides or in fields, but becoming more common on the mountains, especially on the high rock ledges up to 2000 feet on Cnoc Coinnich, to

1900 feet on Ben Reithe, to 1400 feet on the Saddle, and to 1150 feet on Clach Bheinn.

Blaeberry (*Vaccinium Myrtillus*, Linn.)—This is one of the five most widely distributed and commonest plants; a summit plant on all the high hills except Clach Bheinn; absent from the shore, roadside and field flora; frequenting the allts from a low level, but it is from about 1000 feet upwards that it becomes a dominant plant, crowning the edges of rocks. The greatest development of this plant is on the Garbh, Cnoc Coinnich, where it covers acres of the hillside to the exclusion of all else in many places, the only plant which disputes dominance being *Alchemilla alpina*. The Garbh covers a long stretch of hillside from 1500 to 1750 feet, and is of exceptional interest and quite unique.

Cowberry (*Vaccinium Vitis-Idæa*, Linn.)—A summit plant, or nearly so, on all the high hills; seems to be absent south of the Saddle; found in fruit in Eas Garbh as low as 450 feet; from 900 feet upwards becomes frequent on rock ledges. On the summit of Ben Reithe, with *Rhacomitrium lanuginosum*, it dominates the summit flora.

Cross-leaved Heath (*Erica Tetralix*, Linn.)—Plentiful in some parts.

Fine-leaved Heath (*Erica cinerea*, Linn.)—More common than *Erica Tetralix*. The highest position noted was on the summit ridge of the Saddle at 1700 feet. Heathy crowns are well developed on the ice-worn rock faces at the junction of Loch Goil and Loch Long.

Ling. (*Calluna vulgaris*, Salist.)—See Heather Association (p. 6).

Primrose (*Primula vulgaris*, Huds.)—Very common, as seen in spring, near Coilessan, but common, as judged by leaves in summer, along the roadsides, in the woods, up the banks of the allts, and in shady moist places among the rocks on the hills; up to 1500 feet on Ben Reithe.

Wood Loosestrife (*Lysimachia nemorum*, Linn.)—Frequent in shady places, such as the woods, the banks of the streams, and among other vegetation up to 1600 feet on Ben Reithe.

Sea Milkwort (*Glaux maritima*, Linn.)—See Shore (p. 2).

Common Butterwort (*Pinguicula vulgaris*, Linn.)—Common in wet places, specially on rocks and on bare wet banks up to 1800 feet on Cnoc Coinnich.

Pale Butterwort (*Pinguicula lusitanica*, Linn.)—Associated with bog myrtle and sphagnum in a clearing in the wood about 100 feet elevation to south of Lochgoilhead. This is the only place in the district where the flower is known to occur, the nearest of other habitats being in Glen Falloch.

Bog Bean (*Menyanthes trifoliata*, Linn.)—Observed only in boggy ground in the basin of the Lochan burn at an altitude of 600 feet and 800 feet; and in marsh south-west from Coilessan farm, where it is abundant.

Convolvulus (*Calystegia sepium*, Linn.)—On the shore.

Field Scorpion-grass (*Myosotis arvensis*, Hoffm.)—Occasional on low ground.

Forget-me-not (*Myosotis palustris*, With.)—Occasional on low ground; the varieties *repens*, Don., and *cæspitosa*, Schultz., at 1450 feet in Allt Guanán.

Bitter-sweet (*Solanum Dulcamara*, Linn.)—On the shore.

Knotted Figwort (*Scrophularia nodosa*, Linn.)—At low levels.

Foxglove (*Digitalis purpurea*, Linn.)—Common by shore banks, and on rocky places up the allts and on the hills; up to 1200 feet on Steeple Hill above Lochgoilhead, and 1700 feet on the Garbh, Cnoc Coinnich. At the latter place it is a beautiful adornment of the rocky precipice, where it is much exposed. The white variety occurs at low levels.

Thyme-leaved Speedwell (*Veronica serpyllifolia*, Linn.)—Frequent by roadsides, and noted in Eas Garbh at 450 feet; at 1100 feet in Allt Lounin, probably var. *humifusa*.

Common Speedwell (*Veronica officinalis*, Linn.)—Chiefly on rocks, occasionally at low levels, but more frequently on rock ledges in the allts and on the hills; up to 1700 feet on Cnoc Coinnich. It does not occur in the woods.

Germander-Speedwell (*Veronica Chamædrys*, Linn.)—The most frequent of the speedwells, occurring in the woods and on banks at low levels, especially by roadsides, but not in the fields or on the shore-side, and occasionally among other vegetation up to 850 feet on Cnoc Coinnich.

Wall-Speedwell (*Veronica arvensis*, Linn.)—See Roadsides (p. 3).

Eyebright (*Euphrasia officinalis*, Linn.)—Very common, especially on grassy banks at low levels; a constituent of the rush association; frequent on rock ledges up to 1750 feet.

Yellow-rattle (*Rhinanthus Crista-galli*, Linn.)—Plentiful in

some parts of fields, and occasional in grassy parts of the banks of streams up to 1400 feet.

Red-rattle (*Pedicularis palustris*, Linn.)—Occasional on the hills in wet places up to 450 feet.

Pasture-lousewort (*Pedicularis sylvatica*, Linn.)—More frequent and more widely distributed than the former, from sea-level to 1100 feet.

Cow-wheat (*Melampyrum pratense*, Linn.)—Common on dry banks under shade at low levels, often in great abundance. On the mountains the form generally alters to the variety *montanum*; frequently among shaded rock hollows up to 1900 feet. On the Garbh, Cnoc Coinnich, it is plentiful at 1750 feet among the blaeberry.

Gipsy-wort (*Lycopus europæus*, Linn.)—On the shore.

Wild Thyme (*Thymus Serpyllum*, Linn.)—Common on dry banks and rocks and well distributed, but most typically developed from 1000 feet upwards to 1800 feet on dry, rocky places with a shallow earthy covering; apparently absent from shore, roads and low-lying habitats generally; mainly a mountain plant.

Self-heal (*Prunella vulgaris*, Linn.)—Common over the district from the shore-side up to 1500 feet, chiefly on dryish, grassy slopes. It always accompanies the daisy where the latter flower occurs in numbers on the mountains.

Skull-cap (*Scutellaria galericulata*, Linn.)—See Shore Margin (p. 3).

Woundwort (*Stachys sylvatica*, Linn.)—Occasional in the woods and wooded allts at low levels.

Marsh-woundwort (*Stachys palustris*, Linn.)—Occasional on the roadside and by the shore.

Hemp-nettle (*Galeopsis Tetrahit*, Linn.)—At low levels only.

Wood-sage (*Teucrium Scorodonia*, Linn.)—Frequent in dry places on banks, and occasional on dry, shaded slopes and rock hollows, but not noted above 450 feet.

Bugle (*Ajuga reptans*, Linn.)—Occasional in places where water percolates from roadside; up to 1900 feet.

Sea-pink (*Armeria vulgaris*, Willd.)—On shore only.

Greater Plantain (*Plantago major*, Linn.)—At low levels only.

Ribwort Plantain (*Plantago lanceolata*, Linn.)—Very common and widespread, being a constituent in all the grass-like associations from roadsides and shore rocks up to 1900 feet.

Sea-side Plantain (*Plantago maritima*, Linn.)—On shore, and occasionally on lower hill slopes.

Star of the Earth (*Plantago coronopus*, Linn.)—On rocks at the junction of Loch Long and Loch Goil.

Annual Knawel (*Scleranthus annuus*, Linn.)—On roadside.

Halbert-leaved Orache (*Atriplex patula*, Linn.)—On shore only.

Curled Dock (*Rumex crispus*, Linn.)—On the shore.

Broad-leaved Dock (*Rumex obtusifolius*, Linn.)—Almost wholly confined to low levels; occurring occasionally on the shore, and frequently by roadsides.

Sourock (*Rumex Acetosa*, Linn.)—Commonest of the genus; up to 2000 feet on Cnoc Coinnich and 1900 feet on Ben Reithe. In some fields at low levels; very plentiful.

Sheep's Sorrel (*Rumex Acetosella*, Linn.)—Occasional in dryish places up to 1000 feet.

Mountain Sorrel (*Oxyria reniformis*, Campd.)—In rocky bed of streams at high elevations; at 450 feet in Eas Garbh.

Common Knot-grass (*Polygonum Aviculare*, Linn.)—Occurs by roadside.

Spotted Knot-grass (*Polygonum Persicaria*, Linn.)—By shore-side.

Pale-flowered Knot-grass (*Polygonum lapathifolium*, Linn.)—By roadsides and in fields; the commonest species.

Water-pepper (*Polygonum Hydropiper*, Linn.)—In ditches by the roadside.

Alpine-bistort (*Polygonum viviparum*, Linn.)—On Cnoc Coinnich at 1800 feet.

Dog's Mercury (*Mercurialis perennis*, Linn.)—Frequently met with in clumps, and over small areas in the woods, up the wooded allts, and under overhanging rock to 1100 feet; most frequent in shady places to 600 feet.

Crowberry (*Empetrum nigrum*, Linn.)—Well distributed from sea-level up to the summits of the hills; most common above 1000 feet, sometimes on rocks in hollows, but over greater areas on grassy slopes, especially near the tops of the hills, notably so on the Saddle and Ben Reithe. A summit plant on the Saddle, Tom nan Gamhna, Ben Reithe, but absent from Cnoc Coinnich, both summit and upper slopes.

Nettle (*Urtica dioica*, Linn.)—Common in waste places on low ground; also occurring at considerable altitude, e.g., at 1500

feet on Carn Glas, and at 1100 feet on Clach Bheinn, both with western exposure, under overhanging rocks.

Bog-myrtle (*Myrica Gale*, Linn.)—Only occurs from sea-level up about 200 feet, especially in flattish hollows where water remains.

Small Bur-reed (*Sparganium minimum*, Fries.)—In Corran Lochan.

Grass-wrack (*Zostera marina*, var. *angustifolia*, Linn.)—At Lochgoilhead.

Floating Pondweed { (*Potamogeton natans*, Linn.)—In Corran
Lochan.
(*Potamogeton natans*, var. *oblongus*, Viv.)

—Occasionally in wet places and ditches at various places up to 800 feet.

Marsh Arrow-grass (*Triglochin palustre*, Linn.)—Very occasionally in wet places up to 1100 feet.

Sea Arrow-grass (*Triglochin maritimum*, Linn.)—On the shore.

Heart-leaved Tway-blade (*Listera cordata*, Br.)—At 700 to 800 feet, among sphagnum and wet places, round the Steeple and Tom nan Gamhna.

Spotted Orchid (*Orchis maculata*, Linn.)—Occurs in great plenty on the lower slopes in wet grassy places, where it is not over-reached by other plants; also found with diminished frequency up to 1500 feet in sheltered situations.

Butterfly Orchid (*Habenaria bifolia*, var. *chlorantha*, Bab.)—Occurs in considerable quantity in the fields at the head of the loch and not elsewhere, the type form being absent.

Fragrant Orchid (*Habenaria Conopsea*, Linn.)—Not common.

Iris (*Iris Pseudacorus*, Linn.)—Not common, and not on the hills.

Wild Hyacinth (*Scilla nutans*, Sm.)—Common in the woods and in shady moist places at low levels; occasionally higher, as a strong development in a rock hollow near the top of the Steeple at 1200 feet.

Garlic (*Allium ursinum*, Linn.)—Thinly distributed through the woods at low levels, nowhere strongly developed, in some parts absent and in others common.

Bog Asphodel (*Narthecium ossifragum*, Huds.)—Common over Tom nan Gamhna up to moderate levels; probably common elsewhere.

Common Rush (*Juncus communis*, Mey.)—Frequent in places where the subsoil is wet; up to 1300 feet.

Jointed Rush (*Juncus acutiflorus*, Ehrh.)—This species forms great beds of dark green on the hillsides, where both surface soil and subsoil are wet. These beds occur from low levels up to about 1400 feet, and are most strongly developed over the slopes of the south-west end of Corrie Odhair. See Rush Associations (p. 6).

Bog Jointed Rush (*Juncus supinus*, Mœnch.). Lesser Bog Jointed Rush (*Juncus uliginosus*, Sibth.). Frequent on moist banks under shade, in moist places in the woods, and in places on the hillside where water runs gently through herbage and among sphagnum, but apparently confined to levels below 800 feet; frequently viviparous.

Don's Slender Rush (*Juncus tenuis*, Willd.)—Plentiful in places on the roadside.

Heath Rush (*Juncus squarrosus*, Linn.)—From low levels up to within 30 feet of the summit of Cnoc Coinnich; and on the summits of all the other hills, except the southern ridge, and dominating large stretches of the hillsides, especially from about 1000 feet upwards to 1600 feet; in parts subject to considerable dessication.

Toad Rush (*Juncus bufonius*, Linn.)—Common in ditches by the roadsides, and occasionally in wet bare places up to 500 feet.

Three-flowered Rush (*Juncus trifidus*, Linn.)—Plentiful on the rock ledges at 2000 feet on Cnoc Coinnich, and on stony ground on Carn Glas, but not observed elsewhere.

Three-flowered Rush (*Juncus triglumis*, Linn.)—Plentiful on the north-west grassy slopes and base of cliffs on Cnoc Coinnich at 1800 feet.

Round-fruited Rush (*Juncus Gerardi*, Loisel.)—On the shore.

Hairy Rush (*Luzula pilosa*, Willd.)—At low levels; occasional only in shady places.

Wood Rush (*Luzula sylvatica*, Gaud.)—Very frequently met with in dryish places on the banks of the streams and on the open hillsides, and high up on the earth slopes among the rocks of the upper parts of the hills—to 1900 feet on Cnoc Coinnich, to 1400 feet on the Saddle, and to 1800 feet on Ben Reithe. The strongest hillside development is between 1300 to 1400 feet; appears to be absent from the woods proper.

Field Rush (*Luzula campestris*, Br.)—This is the commonest and most widely spread of the wood-rushes; up to 2000 feet on Cnoc Coinnich, and on the summit of Ben Reithe. It is

more common at both low and very high elevations than *Luzula sylvatica*.

Narrow-leaved Blysmus (*Blysmus rufus*, Link.)—In the Saltings only at Lochgoilhead.

Deer's Hair (*Scirpus cæspitosus*, Linn.)—Very common; at considerable elevations; as a tufted social plant covering considerable areas, especially from 1100 to 1500 feet, and occurring from sea-level to 1750 feet. It is widely distributed, but its strong development is most marked in the moors above the heather.

Salt-marsh Club-rush (*Scirpus maritimus*, Linn.)—In the Saltings only at Lochgoilhead.

Hare's-tail Cotton-grass (*Eriophorum vaginatum*, Linn.)—Very seldom seen; occurs near the summit of Cnoc Coinnich at 2470 feet. Probably commoner than observed.

Cotton-grass (*Eriophorum angustifolium*, Roth.)—Very common and widely distributed, from low levels up to 2470 feet on Cnoc Coinnich; often a dominant on peat, and most strongly developed in the moss between Cnoc Coinnich and The Brack.

Creeping Carex (*Carex dioica*, Linn.)—At 1800 feet on the grassy north-west slope of Cnoc Coinnich.

Flea Sedge (*Carex pulicaris*, Linn.)—Common in wet grassy places from low levels up to 1800 feet.

Oval-spiked Sedge (*Carex ovalis*, Good.) and (*Carex leporina*, Linn.)—In fields at low levels only.

Star Sedge (*Carex echinata*, Murr.), (*Carex stellulata*, Good.)—The commonest and most widely distributed of the carices; plentiful in wet places and sides of ditches and burns; also occurring in comparatively dry places, but scattered; from low levels up to 1400 feet.

Distant Spiked Sedge (*Carex remota*, Linn.)—Observed by roadside only.

Common Sedge (*Carex cæspitosa*, Sm.), (*Carex vulgaris*, Fries.), (*Carex Goodenovii*, Gay.)—Frequent from low level up to near the top of Cnoc Coinnich. The forms of this species have not been fully differentiated. *Goodenovii* is commonest.

Rigid Sedge (*Carex rigida*, Good.)—On the rock ledges of the north face of the Saddle at 1400 feet; not observed elsewhere.

Pill-headed Sedge (*Carex pilulifera*, Linn.)—Frequent, with a strange partiality for exposed places and hill-tops

among short grass, and easily escaping observation on account of its drooping habit; in grassy places, rock ledges up to summits of Saddle and Tom nan Gamhna, and within a few feet of the true summit of Cnoc Coinnich.

Pale Sedge (*Carex pallescens*, Linn.)—In sheltered places up to 1000 feet, and especially up the wooded allts.

Yellow Sedge (*Carex flava*, Linn.)—Near to the star-headed carex in frequency, but in drier places up to 1600 feet.

Tawny Sedge (*Carex fulva*, Good.)—One occurrence in the pasture above Lochgoilhead at 150 feet.

Green Ribbed Sedge (*Carex binervis*, Sm.)—About as common as *C. echinata* and *C. flava*, and much commoner on the drier parts in grassy places, becoming tall and handsome on banks and in rocky hollows at considerable elevations; from low levels up to 1800 feet.

Pink-leaved Sedge (*Carex panicea*, Linn.)—Frequent from 300 up to 1800 feet, being especially a mid-level carex.

Wood Sedge (*Carex sylvatica*, Huds.)—Occasional in wooded parts up to a few hundred feet.

Bottle Sedge (*Carex ampullacea*, Gooden.)—The steep nature of the lower slopes prevents the formation of habitats to suit this carex, hence it is found almost wholly at mid levels from 1000 feet upwards to 1500 feet. It is a dominant in the moss at 1500 feet north of the Cnoc, and elsewhere at the same elevation.

Sweet Vernal-grass (*Anthoxanthum odoratum*, Linn.)—Forms a constituent in almost all grass associations, from low levels up to 1800 feet on both Cnoc Coinnich and Ben Reithe. Wherever grass is well developed this one is a dominant, and equally so at low and mid levels; at high levels it occurs more sparsely.

Timothy Grass (*Phleum pratense*, Linn.)—Apparently a casual only.

Floating Fox-tail Grass (*Alopecurus geniculatus*, Linn.)—At low levels only.

Bent Grass (*Agrostis alba*, Linn.), (*Agrostis vulgaris*, With.)—After *Anthoxanthum odoratum* this is the most common grass, and its two extreme forms, *alba* and *vulgaris*, are about equal in frequency. *A. alba* is the commoner grass at considerable altitudes, and *A. vulgaris* at low levels, where it is usually a dominant form in the fields. *A. vulgaris* is also the form usual in the rush associations, but both forms are found

up to 1700 feet. It is only in the autumn, at the flowering and fruiting period, that the widespread prevalence of this grass becomes strikingly noticeable, especially among the heather. The form *pumila* is common on dry terrace edges.

Tufted Hair-grass (*Aira cæspitosa*, Linn.)—Common at low levels, and again common above 1000 up to 2000 feet. Where one might expect *A. alpina* from the vegetative form, an examination of the flowers always indicates *A. cæspitosa*.

Wavy Hair-grass (*Aira flexuosa*, Linn.)—Rather uncommon at low levels, but prevalent on dry banks and on peaty ground from 1000 up to 1750 feet.

Early Hair-grass (*Aira præcox*, Linn.)—This elusive little grass is probably fairly common. It has been observed at several spots at a few hundred feet in dry places with a thin coating of earth over rocks, and is most easily detected in autumn when the grass is bleached white.

Downy Oat (*Avena pubescens*, Huds.)—At Eas Garbh only.

False Oat (*Arrhenatherum avenaceum*, Beauv.)—An occasional grass by the shore banks, by roadsides, and the sides of streams up to 500 feet.

Yorkshire-fog (*Holcus lanatus*, Linn.)—One of the commonest grasses at low levels; with *Agrostis* is dominant in field vegetation. It is frequently found on the hills among rushes up to 1000 feet, and occasionally in other places, but not much above 500 feet.

Soft Grass (*Holcus mollis*, Linn.)—Common in shady places up to about 800 feet, and especially so on the wooded banks of the streams.

Mat Grass (*Nardus stricta*, Linn.)—Absent from the shore, the fields, and the roadsides, but begins to appear at a low elevation; at about 800 feet it becomes a dominant over some considerable areas, especially on the north-west slopes of Cnoc Coinnich, and remains so up to about 1600 feet, thence gradually diminishes to 1750 feet.

Couch Grass (*Agropyrum repens*, Beauv.)—On shore side only.

Rye Grass (*Lolium perenne*, Linn.)—At low levels only.

False Brome (*Brachypodium sylvaticum*, Beauv.)—In Allt Lounin at 50 feet, at Eas Garbh strongly developed at 500 feet, and near the shore among bracken in Corran Bay.

Sheep's Fescue-grass (*Festuca ovina*, Linn.)—Common; the

viviparous form usual above 1500 feet, but occurring down to about 50 feet wherever the conditions are moist. The viviparous form occurs a few feet below summit of Cnoc Coinnich at 2470 feet.

Hard Fescue (*Festuca duriuscula*, Linn.)—Frequent on rock ledges of Cnoc Coinnich and Ben Reithe at 1700 to 2000 feet; also common in moist places along the shore.

Meadow Fescue-grass (*Festuca pratensis*, Huds.)—At low levels only.

Reed Fescue-grass (*Festuca sylvatica*, Vill.)—Frequent in Garbh Allt and Allt Inverlounin, and occasional in other allts.

Cock's-foot Grass (*Dactylis glomerata*, Linn.)—Occasional at low levels.

Crested Dog's-tail-grass (*Cynosurus cristatus*, Linn.)—Frequent at low levels in dryish places, but rarely on the hills, yet dominant over a tract at 1500 feet on the south-east face of Cnoc Coinnich.

Manna Grass (*Glyceria fluitans*, Br.)—At low levels only; common in ditches.

Salt Grass, Sea Meadow-grass (*Glyceria maritima*, Huds.)—On the shore. (*Glyceria aquatica*, Linn.)—In a ditch beside the Glebe at Lochgoilhead.

Annual Meadow-grass (*Poa annua*, Linn.)—Frequent along roads and at low levels, but not common, and very occasionally in patches on the hills at 950 feet near Tom Molach, and strongly developed on the Dog Rock.

Smooth Meadow-grass (*Poa pratensis*, Linn.)—In fields and on Lawns.

Roughish Meadow-grass (*Poa trivialis*, Linn.)—In fields.

Alpine Meadow-grass (*Poa alpina*, Linn.)—Apparently rare: only noticed on Tom nan Gamhna at 1250 feet.

Purple Molinia (*Molinia cærulea*, Mœnch.)—Common and widely distributed from low levels up to about 1750 feet, chiefly on wet ground, and at higher levels also on rock ledges; not usually developing into prominently tufted areas such as is typical of its strong development, but rather as a constituent of mixed vegetation; strikingly noticeable in the late autumn. An extensive area to the south-west of Coilessan is covered with this grass.

Mountain Melic-grass (*Melica nutans*, Linn.)—In allts only, and occasional.

Decumbent Heath-grass (*Triodia decumbens*, Beauv.)—Frequent in drier parts of pastures and on banks, from sea-level up to about 700 feet.

Fir Club-moss (*Lycopodium Selago*, Linn.)—Frequent on rocky ground from 1000 feet upwards, but occasionally lower (800 feet), and ascending to the summit, or near the summit, of all the higher hills.

Savin-leaved Club-moss (*Lycopodium alpinum*, Linn.)—Not widely spread, but locally plentiful above 1500 to 2000 feet, especially on ridge between Carn Glas and Cnoc Coinnich, and on the col between The Brack and the Cnoc.

Lesser Alpine Club-moss (*Selaginella selaginoides*, Gray)—Frequent on wet rocks and among wet vegetation, especially near streams; from 450 up to 2000 feet.

Smooth Horse-tail (*Equisetum limosum*, Linn.)—Forms a belt round the north half of the Lochan.

Wood Horse-tail (*Equisetum sylvaticum*, Linn.)—Among grass near the Lochan, but not noticed elsewhere.

Royal Fern (*Osmunda regalis*, Linn.)—At one time frequent up the allts, from which roots were taken which now adorn many of the gardens at Lochgoilhead. A diminutive specimen was found at 800 feet in the Garbh Allt. Roots were gathered in 1910 opposite Carrick Castle.

Common Polypody (*Polypodium vulgare*, Linn.)—Occasional, but not common; in dry places up to 1750 feet.

Beech Fern (*Polypodium Phegopteris*, Linn.)—Very frequent, especially at mid levels, in shady places on banks, and among rocks up to 2000 feet, but less frequent at low levels.

Oak Fern (*Polypodium Dryopteris*, Linn.)—Occasional in the wooded allts up to 700 feet, in wet mossy places, where it is generally well developed.

Parsley-fern (*Allosurus crispus*, Bernh.)—A trace only on the rocks of Ben Reithe about 2000 feet up.

Holly-fern (*Aspidium Lonchitis*, Sw.)—Below rocks; about 1000 feet on the west slope of Cnoc Coinnich, 1500 and 1750 feet on west face of Ben Reithe, and probably more common, as its habitat makes it somewhat elusive.

Prickly Shield-fern (*Aspidium aculeatum*, Sw.)—Forms of this fern are very frequent on rocks in streams where spray reaches, but the type form does not occur, the commonest form approaching var. *lobatum*, Sm., up to 2000 feet; var.

lonchitidoides, occasionally, at 100 feet in Allt Lounin, at 250 feet in Garbh Allt, at 400 feet in Allt Onich, and occasional in other allts.

Mountain Fern (*Aspidium Oreopteris*, Sw.)—After the bracken this is probably the commonest fern, and is more widely distributed, both horizontally and vertically; its essential is shade. It is most strongly developed and abundant in the hazel and alder wood near Lochgoilhead; it covers patches on the shady slopes of the hillsides; and is plentiful among the bracken. About 1600 feet is the observed limit.

Male Fern (*Aspidium Filix-mas*, Sw.)—Very common, especially at low levels, but frequently occurring on sheltered banks and among rocks up to 1900 feet.

Broad Shield-fern (*Aspidium dilatatum*, Willd.)—Frequent but not occurring anywhere in numbers; showing various forms not yet determined, the mountain form occurring up to 1500 feet.

Lady Fern (*Asplenium Filix-fœmina*, Bernh.)—Common at low levels, and occasional in sheltered places among rocks up to 1750 feet.

Maiden-hair Spleenwort (*Asplenium Trichomanes*, Linn.)—Not common at low levels, but covering the walls of the bridge over the Goil; common at moderate levels in rocky hollows and sheltered rock faces up to 1750 feet, and well distributed all over the district.

Green Spleenwort (*Asplenium viride*, Huds.)—Common on rocks in the allts from 500 feet upwards; very frequent on wet rock hollows, from 1000 to 2100 feet; at mid levels from 1000 to 1500 feet. The two last named are frequently found together or near each other.

Black Spleenwort (*Asplenium Adiantum-nigrum*, Linn.)—Occasional on rocks at various parts of the district; near sea-level at the Dog Rock; up to 1100 feet on Clach Bheinn, and 1000 feet on the Steeple.

Wall-rue (*Asplenium Ruta-muraria*, Linn.)—Occasional on shaded rock faces and walls, chiefly at low levels, and rarely ascending, highest noticed being at 1200 feet on the Steeple.

Tongue Fern (*Scolopendrium vulgare*, Sm.)—Very rare, only at one place in a stream gorge near the Dog Rock.

Hard Fern (*Blechnum boreale*, Sw.)—Very common on fairly dry banks, especially near the top, in which position it is characteristic of the roadside vegetation. It occurs among bracken, on banks of streams, in the woods on banks and stumps, and on the hills in shady places among rocks up to 1750 feet.

Bracken (*Pteris aquilina*, Linn.)—Abundant and strongly developed wherever the ground slopes sufficiently to give good drainage; from sea-level up to about 800 feet. It sends strips and patches in sheltered hollows up to about 1100 feet, at which level its development is weakened and gives place to other social species. It is displaced by *Aspidium Oreopteris* in the alder and hazel woods, but dominates the ground vegetation in the birch and oak woods; it is displaced in many places on the hillsides by rushes or by heather.

Brittle Bladder-fern (*Cystopteris fragilis*, Bernh.)—Very frequent under rocks in moist earth from 1400 to 1800 feet, and occasionally descending the allts as low as 600 feet. Under some of the ledges it is very plentiful.

Scottish Filmy-fern (*Hymenophyllum Wilsoni*, Hook.)—Occasional on rocks in the allts from low levels upwards, and forming cushions on the rock ledges of the Saddle at 1400 feet.

TREES AND SHRUBS.

Birch (*Betula alba*, L.)—The commonest tree all round the shore slopes, sometimes alone, more often associated with oak in coppice up to about 600 feet; trees are generally young, very few large; ascending the allts to 1000 feet.

Alder (*Alnus glutinosa*, Gaertn.)—Forms woodland with hazel near Lochgoilhead, and also common on the slopes into Corran Bay; its occurrence elsewhere not observed; limited to about 500 feet.

Hazel (*Corylus Avellana*, L.)—Common along the roads and up the allts, but best developed with alder in the woodland near Lochgoilhead. Frequent up the allts, and generally limited to about 500 feet.

Oak (*Quercus Robur*, L.)—After birch, the commonest tree all round the coast and up the allts, the woodland strip varying in altitude but attaining about 600 feet, many scattered oak trees occurring on the otherwise bare hillsides; trees are mostly young or under a hundred years.

Beech (*Fagus sylvatica*, L.)—A few trees by the side of the River Goil.

Least Willow (*Salix herbacea*, L.)—Frequent on the rock ledges; from 1400 feet up to very near the summit of Cnoc Coinnich at 2470 feet. (*Salix*——(sp.)) Species of willow are frequent by the sides of the streams and in sheltered places on the hillsides, but these have not been distinguished.

Aspen (*Populus tremula*, L.)—On Mulan Iubhair at 400 feet in a rock gully.

Boortree or Elder (*Sambucus nigra*, Linn.)—Some stunted trees at Guanamore.

Holly (*Ilex Aquifolium*, L.)—An occasional constituent throughout the woodland, some of the trees being large and of good age; to moderate elevation only. A few very old trees adorn the rock crevices of Mulan Iubhair; not above 600 feet.

Larch (*Larix europæus*, D. C.)—Some well-grown larches at low levels along garden boundaries, but only once or twice on the hills; in Garbh Allt at 650 feet at the limit of the wooded part of the allt.

Common Dog-rose (*Rosa canina*, L.)—Varieties are occasional at low levels.

Broom (*Cytisus scoparius*, Link.)—Not common; occasional on dry banks at low levels.

Whin (*Ulex europæus*, Linn.)—Not widely distributed; one stretch close to the roadside near the village, and an occasional clump in other parts; up to 400 feet in Corrie Odhair.

Wych Elm (*Ulmus montana*, Stokes)—A few trees in the village and one in Allt Onich.

Common Juniper (*Juniperus communis*, Linn.)—Only one bush at 250 feet in Allt Inverlounin.

Juniper (*Juniperus nana*, Willd.)—A clump on the cliffs of Ben Reithe at 1750 feet with south exposure.

Yew (*Taxus baccata*, Linn.)—One tree noted; probably more on the cliffs above Mulan Iubhair.

Scots Fir (*Pinus sylvestris*, Linn.)—In gardens only, but many large trees on Drimsynie estate.

Rowan (*Pyrus Aucuparia*, Ehrh.)—Very frequent in the woods and by the sides of streams at low levels, and by the sides of the streams and in crevices on the face of cliffs up to 1750 feet. In the allts it ascends higher than any other tree, the highest noticed being at 1200 feet in fruit, while

diminutive trees may be found almost at the summits on rock ledges.

Sloe (*Prunus spinosa*, Linn.)—Only noticed at one place on the shore.

Hagberry or Bird Cherry (*Prunus Padus*, Linn.)—Observed at Guanán.

Ash (*Fraxinus excelsior*, Linn.)—Very frequent throughout the woodland, and up the wooded allts, becoming in some parts the commonest tree after the birch. Common by the roads at the head of the loch, and six fine trees in Corran Bay, having been planted beside former dwellings. Ascends to 1200 feet in the allts, and 1100 feet on the cliffs; a frequent companion of the mountain ash.

Sycamore (*Acer pseudo-platanus*, Linn.)—Some large trees in the village; not ascending the allts beyond 100 to 200 feet.

Horse Chestnut (*Æsculus Hippocastanum*, Linn.) In the low levels.

Hawthorn (*Cratægus Oxycantha*, Linn.)—A very frequent constituent of the woodlands and of the wooded allts, but only for the first 400 feet.

Lime (*Tilia vulgaris*, Huyne.)—In gardens only, but many trees on Drimsynie estate.

THE ILLUMINATION OF MICROSCOPIC OBJECTS.

BY J. R. JACK, M.I.N.A.

(*Read 10th September, 1912.*)

ALTHOUGH most naturalists make considerable use of the microscope comparatively few obtain the best results which are possible. Considerable care is spent in focussing the instrument upon the object, but the observer is frequently puzzled to know why the same object can be seen very much better on some occasions than on others. In most cases this is due to variations in the illumination, and to obtain what is known as a "critical" image it is necessary to take as much care with the optical system on the condenser side as with that on the objective side. This may easily be seen by considering the principles underlying microscopic projection. In fig. 1, let O be the object and L the object glass.

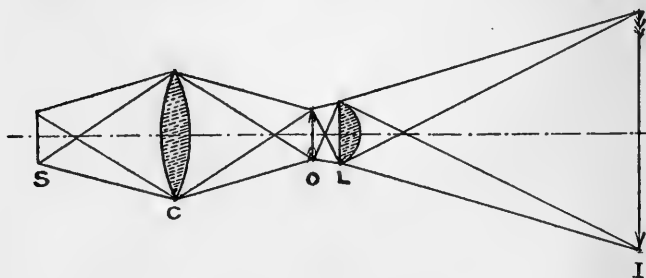


Fig. 1

From every point in O rays diverge, some of which fall upon the object glass L, which brings them to a focus at the corresponding or "anti point" in the image. This image may either be received on a sensitive plate or may be further enlarged by means of an eye-piece. Since the image is formed only by rays which have followed such paths it is evident that no other light is of any value in forming the

image, indeed it may be seriously detrimental. In the case of objects illuminated by transmitted light,—and these are by far the most numerous,—the illumination should be such that the rays falling upon each point of the object shall arrive in a similar manner to that in which it is intended they shall depart on their voyage through the object glass. To achieve this result it will be necessary that the condenser C, and the source of illumination S, shall be arranged so that rays coming from any point in S shall focus at an anti-point in O. In fact the optical arrangement on the condenser side is precisely similar to that on the object glass side. It follows that an image of the source of illumination will be projected on the object by the condenser, and an image of this image will be projected by the object glass into the plane of the image of the object itself. This condition imposes certain restrictions on the nature of the source of illumination employed. For low magnifications the flat side of a paraffin flame cannot be beaten, as it gives a plane surface of fairly uniform intensity. For higher powers the edge of the flame may be used. For the very highest the incandescent filament of a Nernst lamp gives good results, but for lower powers it would not be wide enough for its image in the plane I to cover the image of the object. If an incandescent gas mantle be used as the illuminant its image will be seen shining through the image of the object, and the same applies to an ordinary incandescent electric lamp. If either of these be used with ground glass in front the ground glass may be treated as the source of illumination, in which case the image of each facet of the ground glass will be projected into the plane I, and will show as a muddling of the surface. For visual examination, then, no illuminant is so satisfactory as the old-fashioned paraffin lamp. In setting up the instrument a low-power objective should be focussed on the object, and the condenser racked up or down till the image of the lamp flame is clearly seen, when it is known that the flame is accurately focussed *on the object*. Any higher powered objective may then be used without disturbing the condenser system. It will be seen from the diagram that there is only one position of the illuminant for any given position of the condenser relative to the object, viz., that in which the illuminant is in the conjugate focus to the object. If the condenser

be shifted nearer the object the illuminant will have to be removed farther away, and a smaller cone of rays will fall upon the condenser, thus reducing the intensity of illumination. If the condenser be moved closer to the illuminant a greater cone will be intercepted, but there will be a smaller angle of illumination at the object. These difficulties may be got over by using two condensers, the first, which is generally of the "bull's eye" type, acting as a paralleliser, and having the illuminant at its principal focus. This lens projects a parallel beam along the optic axis. If the main condenser be now so placed that the object is in its principal focus the parallel rays proceeding from the paralleliser will focus exactly on the object, and critical illumination will be obtained. This arrangement can be set up by placing a light as far as possible from the condenser, and racking the condenser up till the image just begins to lose sharpness; the condenser is then adjusted for parallel rays. The bull's eye is adjusted to the illuminant so as to throw a sharp image of it on the farther wall, or it may be reflected up to the ceiling, and an iris diaphragm is used to reduce the size of the disc to that of the aperture in the principal condenser. The lamp and bull's eye may then be put into the optic axis, taking care to keep their relative distance constant. As the rays between the bull's eye and condenser are practically parallel the distance between these two is unimportant, and may be great enough to admit of various light filters being interposed. When this has been done correctly a transparent object is seen as if it were floating *on* a sea of light; when illumination is not critical it appears to be swimming *in* a luminous fog.

When it is desired to photograph the image the question of colour in the object becomes important.

The ordinary photographic plate is insensitive to red and very feebly sensitive to green light, while it is strongly sensitive to violet and invisible ultra violet light. With panchromatic plates the range of sensitiveness extends through the whole spectrum, and it is possible by using suitable filters to cut out certain parts of the spectrum and allow the photograph to be taken only by means of a selected narrow band. In the case of a subject faintly stained with violet or purple a photograph on an ordinary plate would be practically hopeless, because the light passing through the object would act as

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FIG. 2.

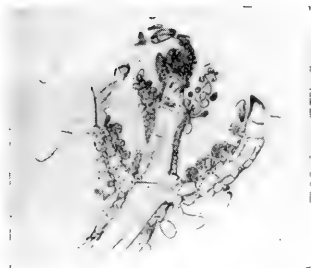
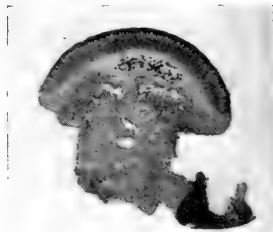
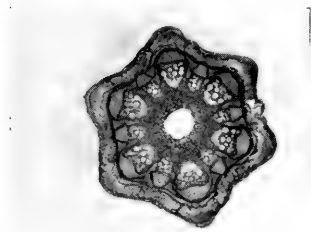
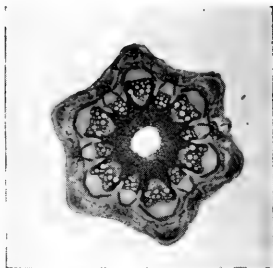


FIG. 3.



From Photos by

FIG. 4.

FIG. 5.

[J. R. Jack.

- FIG. 2. *Chara fragilis*.
FIG. 3. Stem of *clematis*.
FIG. 4. " "
FIG. 5. *Stereocaulon coralloides*.

powerfully on the plate as the light which passed the sides of it. Now a purple object absorbs green light from the middle of the spectrum and transmits red and blue from the ends, so that if a green filter be introduced between the bull's eye and the condenser the only light which falls upon the object is of the colour to which it is opaque. The green light passing the object affects the sensitive panchromatic plate, but that which falls upon the object is completely stopped and the plate is unacted upon in way of the image, which appears on the developed negative as almost clear glass. An example of this is shown in fig. 2, which represents a longitudinal section of *Chara fragilis* which has been stained faintly with gentian violet and photographed with green light. This method lends itself to the resolution of detail, which is sometimes invisible by direct observation. In fig. 3 is reproduced a photo-micrograph of a transverse section of *Clematis vitalba* doubly stained and taken upon an ordinary plate, while in fig. 4 is the same object photographed on a panchromatic plate with a green filter interposed. The sclerenchyma, which is quite invisible in the first photograph and could scarcely be detected by ordinary illumination in the microscope, is very clearly defined in the second photograph. By photographing a coloured object with light of the colour which it absorbs any desired amount of contrast can be obtained. This, of course, can be overdone, and excessive contrast obtained at the loss of detail. For objects possessing contrast in themselves it is better to photograph with the colour which the object transmits, as this brings out detail to its fullest advantage. Like all other processes this must be used with discretion, but it is easy to try one or two filters and compare the results, when the best can be selected. When these points are attended to, the definition should be sufficiently sharp to show the minutest details, and even the marks sometimes left by the microtome knife in cutting the sections may be rendered on the plate. An example of this may be seen in fig. 5, which shows a section of the lichen *Stereocaulon coralloides* under critical illumination.

THE MAIN LINE OF DESCENT THROUGH THE GREEN ALGÆ.

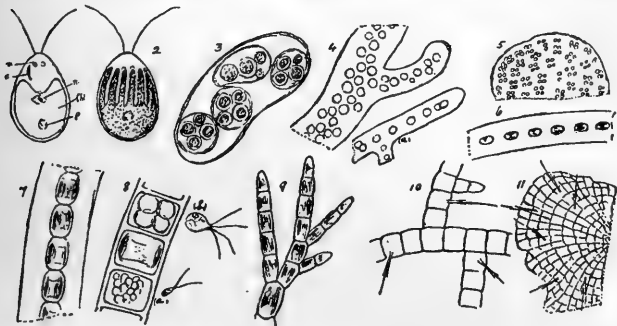
BY GEORGE LUNAM.

(*Read 10th December, 1912.*)

WITHIN recent years much work has been done in elucidating the inter-relationships of the Chlorophyceæ, and in the following pages a somewhat popular account is given of what may be regarded as the main line of plant descent, so far as it lies among these lowly forms. Almost at the foundations of the vegetable kingdom are a few groups of motile organisms back to which several lines of descent have been traced. The forms, however, that give us the starting point that seems to lead to the line ending in the higher plants belong to a very simple unicellular genus, *Chlamydomonas* (figs. 1 and 2), a few species of which are common in our area. *Chlamydomonas*, a walled unicell, as the name implies, contains a somewhat basin-shaped or bell-shaped chloroplast, has an eye-spot, a pair of equal cilia by which it moves about in the water where it is found, and a pair of contractile vacuoles. When reproduction is about to take place the cell comes to rest and divides up into two to eight daughter cells which on liberation become new individuals; sometimes the cell divides into as many as sixty-four, but these (gametes) on liberation fuse in pairs, giving rise to zygospores which produce new individuals. Some species under suitable conditions enter a stage known as the "palmella state"; and others seem to be mainly in this condition—a resting period in which the cells have lost their cilia and are embedded in mucilage derived from the cell wall (fig 3.)

The emphasising of this condition by the adoption of a vegetative mode of increasing the number of resting cells has probably led on to the higher developments shown in the Chlorophyceæ. It is from this simple organism in its motile state that the evolutionist readily traces a very clearly marked

line leading to and ending in *Volvox*—the highest form that could evidently be produced by a *Chlamydomonas* type which could not give up its motility. However, it is from the palmelloid condition that the greatest developments have arisen, and a little consideration will show that there are so many directions along which advance can be made by a non-motile organism that many complications may be expected. This is found to be so, there being many side branches from the main line leading to special developments that have ended blindly by becoming highly specialised. A group of forms



(1) Diagrammatic representation of *Chlamydomonas*: *chl*, Chloroplast, *n*, nucleus, *e*, eye-spot, *v*, contractile vacuoles, *p*, pyrenoid; (2) *Chl. Kleinii* Schm., from Bowling; (3) *Chl. Braunii* Gor, palmella condition (after Lotsy), evidently showing vegetative division; (4) *Palmodactylon varium* Näg, from Glen Falloch, (a) from Strathblane (both diagmc.); (5) *Tetraspora gelatinosa* (Vauch.) Desv. (diagmc.) from Gourcock; (6) *Hormospora* (sp.?) from Strathblane; (7) *Hormospora mutabilis*, Bréb., from Bute; (8) *Ulothrix zonata* (Web. et Mohr.) Kütz., (a) microzoogonidium, (b) macrozoogonidium; (9) *Chatophora incrassata* (Huds.) Hazen, from Possil. (Small portion from end of a branch); (10) Outline of portion of a species of *Coleochaete*, from Strathblane; (11) Portion of thallus of *Coleochaete scutata* Bréb., from Bardowie Loch.

known as the Palmellaceæ is readily derivable from *Chlamydomonas*, in fact it might almost be said they are non-motile *Chlamydomonads*, *i.e.*, non-motile in the main, for in reproducing, zoospores and gametes recalling in detail those of that unicellular genus are formed. In *Tetraspora* (fig. 5), which forms large gelatinous masses in pools, etc., and is fairly common in "Clyde," there is a tremendous vegetative increase by division of cells, usually into fours, but eventually motile cells harking back to the primitive type are produced for reproductive purposes. The line of development under consideration is usually spoken of as being due to the "tetrasporine tendency"

of some primitive *Chlamydomonas*, but it must be noted that tetraspora-like forms have probably yielded as their highest expression the marine genera *Ulva* and *Enteromorpha* and the freshwater *Monostroma*. One of the simpler forms of the Palmellaceæ—*Palmodactylon* (fig. 4)—has irregularly scattered cells in the containing mucilage, but a single row of cells is not uncommon, and probably from some such form was evolved the first filament by the formation of distinct walls between the cells. The simple filament is well illustrated by the familiar *Ulothrix*. Closely allied to *Ulothrix* is a form that has been observed from a few stations in the west of Scotland—*Hormospora*—in which there is no definite wall between the cells, which may be quite separated from each other (figs. 6 and 7). This might be taken as an intermediate step between the palmelloid stage and *Ulothrix*, or, at anyrate, might be taken as indicating the line along which development has proceeded. That the *Ulothrix* filament (fig. 8) is derivable from *Chlamydomonas* through the Palmellaceæ seems indisputable—it is hardly necessary to refer to the close similarity between its reproductive organs (zoospores and gametes) and the primitive unicell from which we started—and once granted this step there is no difficulty in leading to the higher forms. It is worth noting in passing that we have here a remarkable extension of the resting period overshadowing the essential motile period which must be resorted to for reproduction. In fact the history of the whole line is “a history of the intercalation of a vegetative phase between two successive motile (*Chlamydomonadine*) phases” (1). The derivation of a branched thallus from the simple filamentous forms presents no difficulty, and there is no doubt that the *Chætophoraceæ* are descended from an ulotrichaceous ancestor (fig. 9). Certain forms along this line have tended towards a terrestrial existence, as in *Pleurococcus*, which forms a green covering on stones, tree-trunks, etc., and seems to be a reduced member of the *Chætophoraceæ*; and in *Trentepohlia* (*Chroolepus*), which is common on damp and somewhat shaded walls and rock faces, our species being readily recognisable by their brownish-red colour.

Another interesting group forming the genus *Coleochæte* has evidently arisen directly from branched *Chætophorales*; the simplest forms have a simple branched thallus (fig. 10), but our commonest species, *C. scutata* (fig. 11), occurring

abundantly on submerged stones and stems of water plants, has a flat parenchymatous thallus composed of branched filaments fused laterally. Biciliated zoospores (zoogonidia) are formed reproducing the plant asexually, but the sexual reproduction is heterogamous—highly specialised oogonia after being fertilised by antherozoids producing a spermacarp, from which biciliated zoospores escape, giving rise to several rudimentary asexual generations. There is considerable evidence that the *Edogoniaceæ* (*Edogonium* and *Bulbochæte*) arose from ulotrichaceous ancestors, and Prof. Oltmanns has suggested the origin of the *Cladophorales* from the line, but probably the brief account given will be sufficient to enable the botanist with but little knowledge of the green algæ to glean a general idea of current thought on this subject.

Somewhere along the line, among the branched forms, there seems to have arisen the *Bryophytes*, which are not far removed from it in their protonemal existence. To the ferns is not a great remove, and recently it has been shown that among the plants of past ages were fern-like plants, at first thought to be ferns and named as such, that reproduced by seeds, thus bridging over what used to be considered the greatest gap in the evolution of the higher plants—that between the *pteridophytes* and the *spermaphytes*.

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THE LIMICOLÆ OF THE CLYDE AREA.

BY JOHN ROBERTSON.

(Read 11th March, 1913.)

OF the order Limicolæ, which includes the waders, thirty-five species have been recorded for the Clyde area. Of that number only ten species, marked with an asterisk, nest within our limits. Twelve others are more or less familiar either as birds of passage or as frequenting our coasts during the winter months. Of the remainder, five are infrequent and uncertain visitors, and eight are known only as rare stragglers.

Stone-Curlew (*Edicnemus scolopax* (S. G. Gmelin))—One shot at Muirhouse, Baldernock Parish, in August, 1895, is the only occurrence known of this species in the area. ("Annals of Scottish Natural History," 1897, p. 225.)

Cream-coloured Courser (*Cursorius gallicus* (J. F. Gmelin))—There is only one record, a bird shot near Lanark, 7th October, 1868. (Gray, "Birds of the West of Scotland," p. 250.)

*(?) Dotterel (*Eudromias morinellus* (L.))—Old or comparatively old records of this species refer to the Kells Range on the south-east side of Loch Doon (R. Service); near Glasgow (Gray); Carluke Parish (D. Pringle); Loch Ranza (MacGillivray); and Luss ("Statistical Account of Scotland," 1796). Within recent years single birds have been seen or obtained at Bellshill, Kilchattan Bay, and Blantyre. There is a probability that a very few birds may still breed on the Galloway Hills just south of the Ayrshire border, as on 17th July, 1898, on Benyellary, I heard and saw indistinctly through the mist a bird which I believe was a dotterel. Elsewhere in the area it is a very rare straggler. The dotterel has a peculiar jarring note, difficult to describe, a little like one of the notes of the turnstone, but not so loud or distinct.

*Ringed Plover (*Ægialitis hiaticola* (L.))—This is an abundant species by the shores of the Firth of Clyde, and

it is frequently observed, sometimes in numbers, by inland waters, especially at the period of the autumn migration. The ringed plover is a sprightly and engaging bird, and prefers to nest on sandy and gravelly beaches, though the nest may be found in fields at some distance from the shore, but it is not known to nest in any strictly inland locality in Clyde. The nest is simply a hollow scooped in the ground, often lined with a few stalks of herbage and some white shells. The four eggs are placed with their pointed ends inwards and downwards, so as to occupy the least possible space. Incubation begins towards the middle of April, though a nest containing two eggs has been found at Lendalfoot by Mr G. Graham as early as the 9th of March ("Scottish Naturalist," 1912, p. 165). A few late nests may be found till the third week of July.

While the ringed plover is quite familiar on the shore all the year round, the greatest numbers are seen in the autumn months, and the fewest in early spring. In May, when the full resident population is here, the numbers seem to be much less than in autumn. Probably many of the autumn birds, like those of other species, go south never to return.

*Golden Plover (*Charadrius pluvialis*, L.)—Abundant from autumn to spring near the shore, and inland when the weather is open, severe frost driving the inland birds down to the coast. Some idea may be formed of the numbers of this species present in winter, when I state that on New Year's Day, 1913, in a walk of seven miles, from Neilston to Thornliebank, I saw several mixed flocks of golden plovers and lapwings, aggregating between 5000 and 6000 birds, and probably half of these were golden plovers. In summer but a tithe of these numbers remain to nest on our moors at a considerable elevation. I am not aware of them nesting anywhere in Clyde under the 500-foot contour line, and I have seen nestlings at nearly 2000 feet on Benyellary, just beyond our limits.

From early March, according to the season, the return to the breeding haunts is made, and the wild, clear note of the golden plover on its native moor is one of the delightful sounds of spring that quicken the pulse of the lover of nature.

The spring note has been rendered "*jud-ee-a*," but the

ordinary call-note is a single, clear, plaintive whistle. A similar but more hurried note is often heard aloft at night, as the birds rush through space. The nest is usually placed on rather barren and open ground, often on the bare peat, and there is no attempt at concealment. The handsome eggs, of which four are a clutch, are sometimes laid on the Mearns Moors by the first week of April, but from the middle to the end of that month is the usual time, and a few nestlings may be seen at greater elevations until the third week of July. The young in down are perhaps the most beautiful of all our local nesting waders, being delightful little balls of greenish-yellow fluff, as if intended to harmonise with the sphagnum patches.

Grey Plover (*Squatarola helvetica* (L.))—The grey plover comes to us from the Arctic circle from September onward. It is almost entirely a shore bird, and even there it is seldom seen in parties of more than six or eight individuals. On 30th September, 1912, Mr Robert Wilson saw from fifty to sixty birds pass him singly and in twos and threes during a period of about three hours which he spent on the shore at Fairlie. This is the greatest number recorded for one day by any observer in the Clyde area. I have twice in autumn seen a single bird inland, in 1895 and again in 1901, at Balgray Dam in East Renfrewshire, and, as far as I know, these are our only inland records. The note of the grey plover is quite distinct from that of the golden plover, being known as a double note, while that of the latter species is known to shore shooters as a single note. The birds themselves have usually a much lighter appearance than the golden plovers, their large dark eyes being most conspicuous against their light plumage. They have a good deal of white on the lower back and their axillaries are black, while in the golden plover the lower back is dull and the axillaries are white.

*Lapwing (*Vanellus vulgaris*, Bechstein)—The lapwing is at all seasons the most common of our local waders. From autumn to spring flocks of several thousands may often be seen inland as well as near the sea, unless in severe frost, when the inland birds retire to the coast, and many leave our area altogether until the return of mild weather. In the nesting season it is widely and abundantly distributed, affecting all sorts of open ground from the spring-tide mark

to the lower slopes of the mountains. In our lowland districts it begins to nest in the last week of March, a little later in the uplands, and nests may be found till the end of June. From personal observation I cannot say that I have noticed much difference in the numbers of this species during the last thirty years, but I believe it would be even more abundant if its eggs were entirely protected by law, instead of partially as at present. Previous to the passing of the Act, which protects their eggs after the 15th of April in each year, the public generally were under the impression that it was illegal to take lapwings', or indeed any bird's eggs. Now many persons make a practice of lifting every lapwing's egg possible up till the 15th of April, and, unfortunately, long after that date, so that instead of benefiting by the Act of Parliament the lapwing has actually suffered. The late Charles Berry of Lendalfoot held this view, with which I still agree.

Turnstone (*Streptilas interpres* (L.))—Wherever there are low-lying rocks or the shores are rough, round the Firth of Clyde, the turnstone is a common bird from August till June, mostly motley and nondescript in plumage in autumn, but exceedingly beautiful in May. It occurs in flocks, varying in size from a few birds up to about seventy. A stray bird or two occasionally occur inland, as at Balgray Dam in August, 1911. The turnstone is not a shy bird, and may be watched from a near distance as it searches for food under a heap of seaweed or other tide-borne rubbish. It has a peculiar twittering or crackling note, especially in flight, and it has also a loud clear whistle.

Though not known to nest nearer than Iceland, I have seen birds in June in Bute courting and behaving pretty much as if they intended to nest in the vicinity.

*Oyster-Catcher (*Hæmatopus ostralegus*, L.)—All round the Firth of Clyde the oyster-catcher is common. Inland it is often heard passing over by night as well as by day, and it is frequently seen by the edge of lochs and reservoirs. For nesting purposes the more secluded shores are preferred, and it nests regularly on Loch Lomond. In a recent year a pair nested on the River Clyde, near Hamilton, as Mr H. J. Rhodes kindly informed me. Nesting commences by the beginning of May, but fresh eggs may be found till the middle of July. The site selected is most often among gravel or sand

just on the shore, but frequently the nest is placed among grass some distance back; sometimes a depression in a low-lying rock is chosen. The nest is a slight hollow lined with a few stems and often with some shells. The number of eggs is usually three, but nests with four are not uncommon. Until the eggs are hatched the oyster-catcher when alarmed slips off its nest quietly and runs or flies some little distance away, but when the young are out the old birds are most vociferous, and their cries do not cease so long as the intruder remains within their territory. At all times a sociable bird, the flocks grow in size after the nesting season till, as autumn progresses, congregations of many hundreds may be seen at certain favourite feeding grounds.

The oyster-catcher is a handsome bird, with his pied plumage, red legs, and loud, clear call. He loves to search for cockles and such fare at low tide, and when the water covers his feeding place he retires with his neighbours to some rock or field near by, there to dose till the ebbing tide lays bare his next meal.

Black-winged Stilt (*Himantopus candidus*, Bonnaterre)—The only records are one killed near Port Glasgow in 1850 (Gray, "Birds of the West of Scotland," p. 303), and another observed at Possil Marsh in 1867 (Gray in "Notes on the Fauna and Flora of the West of Scotland," 1876, p. xiii).

Pectoral Sandpiper (*Tringa maculata*, Vieillot)—One was obtained near Loch Lomond in November, 1882. (Saunders, "Manual of British Birds," 1899, p. 579.)

Grey Phalarope (*Phalaropus fulicarius* (L.))—There are only a few records of storm-driven birds obtained in early winter in Ayrshire and Renfrewshire.

*Woodcock (*Scolopax rusticula* L.)—Common in certain districts of the area at all seasons, shunning heavy, clayey soils, where a few occur in winter. It is a bird that the ordinary observer seldom sees, but in localities where it breeds it may be observed, in the twilight of the summer evenings, flying over the tree-tops or the bracken-clad hillsides, emitting its short, high-pitched whistle, followed immediately by its frog-like croak. It seems to me that when it is emitting the guttural note the wings labour more than at other times, as if the bird were marking time to its croaking. Nesting usually begins with the month of April, and fresh eggs have been

found in the area in August. The nest is often, though not always, carefully concealed among bracken, heather, long grass, or under a bush. The woodcock nests among bracken and rough growth on dry hillsides as well as in woods, indeed, anyone looking at a woodcock on its nest among bracken would be inclined to agree that the markings of its plumage have been evolved to harmonise with the withered bracken.

Great Snipe (*Gallinago major* (J. F. Gmelin))—An occasional visitor mostly in autumn or early winter. It has been obtained or observed several times in Ayrshire, twice in Argyll, five times in Renfrew, twice in Dumbarton, and once in Lanark.

*Common Snipe (*G. caelestis* (Frenzel))—In spring and summer common in many suitable localities. In others, for example South Ayrshire, which seem to be quite as suitable, it is unaccountably scarce. From autumn to spring it is more widely distributed, often occurring in hundreds. Nesting commences early in April and continues through May to June. The snipe has several vocal notes, the well-known “*scape, scape,*” when flushed at any time, “*tinker, tinker,*” and “*djepp, djepp,*” in the nesting season, and then there is the wonderful drumming sound in the spring when the bird is careering aloft round the place where his nest is situated. If the snipe is watched while the drumming is heard it will be seen to be descending rapidly with its tail outspread, the outer pair of feathers held stiffly apart from the others. Just as it reaches the lowest point of the descent it closes its tail and ascends again, to repeat the performance many times over. The sound is never heard unless the tail is expanded, and only when descending—the steeper the descent the stronger the drumming. Just before it makes the downward dive the bird spreads out its tail and flies a short distance horizontally without producing any sound. As far as I have been able to notice there is no difference in the beat of the wings while the drumming is being performed. They are moved as rapidly just before and after drumming, and I am satisfied that they do not help to produce this sound.

Jack Snipe (*G. gallinula* (L))—A winter visitor arriving from September onwards. It is seldom seen and then usually singly. Owing to its habit of squatting it is often overlooked. However, if it is raised, it flies away quietly in a somewhat flickering manner, and drops to earth again at a short distance.

*Dunlin (*T. alpina*, L.)—The dunlin is the most abundant wader from autumn to spring on the shores of the Firth. In summer comparatively few are seen at the coast, as the majority have retired northwards or to inland nesting localities. A few, however, nest on wet ground by the shore in certain districts. Those birds which breed inland begin to return to their haunts towards the middle of April. In the nesting season the bird is local, and only in one or two districts is it common, affecting upland grassy moors in the vicinity of sheets of water. The nest is usually well concealed among withered grass, and the eggs, which are very pretty, are laid from the 30th of April onwards. By the end of July old and young have left the nesting grounds, but dunlins, which are on passage, may be seen regularly by the margins of lochs and reservoirs till the end of October—sometimes till the middle of November. They are also noticed on passage, but in smaller numbers, in April and May. In breeding plumage the dunlin is a handsome little bird with a conspicuous black breast and back variegated with chestnut and black. Its best-known note is a trilling one, somewhat like the sound of a feeble alarm-whistle.

Little Stint (*T. minuta*, Leisler)—The little stint is rather scarce, occurring on the shore in small parties, usually in autumn. Inland a few birds were seen at Balgray Dam in September, 1905. When seen in autumn the little stint has the appearance of a small dunlin with light margins to most of its feathers. Its flight is more wavering and erratic than the dunlin's, and its note is more closely related to that of the curlew-sandpiper.

Curlew-Sandpiper (*T. subarquata* (Güldenstädt))—A regular autumn visitor usually in small numbers. With us it has probably been observed more often inland than on the coast, chiefly I believe because it is easier to patrol effectually the margins of inland waters than a vast expanse of sea-shore. It occurs nearly every autumn at Balgray Dam, where about twenty birds have been seen in one flock. On the ground this species and the dunlin may quite easily be confused in their autumn plumages, but the curlew-sandpiper seems to stand higher than the dunlin and to have a greater angle in its legs when probing the mud for food. It is decidedly the shier bird and on the least alarm flies off with a strong flight.

Then the difference between the species is easily noticed, as the curlew-sandpiper displays a conspicuous white rump, and, owing to its longer wings, flies with greater ease than the dunlin.

The note is a musical "*treep, treep*," allied as stated above to that of the little stint. Sometimes the note is prolonged, but it is always clearer and pleasanter than the "*skree*" of the dunlin.

Purple Sandpiper (*T. striata*, L.)—A winter and spring resident on some of the rough shores of the Firth. It is common in South Ayrshire in the neighbourhood of Lendalfoot, but elsewhere it seems to be scarce, though it occurs near Portincross, in the Greater Cumbrae, and in the Kyles of Bute. Exceptionally it has strayed to Loch Lomond. It is a tame and confiding species, affecting rough and boulder-strewn parts of the coast.

Knot (*T. canutus*, L.)—A common autumn visitor to the coast. It was seen inland at Balgray Dam in the autumn of 1911, a flock of twenty-four remaining for several days ("Glasgow Naturalist," Vol IV., p. 8). It is perhaps the least shy of all our waders, and allows of a comparatively near approach. It flies rapidly and in compact flocks, resembling the golden plover in this respect.

Sanderling (*Calidris arenaria* (L.))—An autumn and spring visitor to our sandy shores in flocks ranging from a few birds up to about twenty-five. A few may be seen even in mid-winter. In autumn and winter the sanderling may usually be distinguished by its light plumage, the under-parts being as white as those of a gull. If one gets a small flock of sanderlings isolated the birds are not particularly shy, but keep racing on in front by the water's edge, always at, to them, a safe distance from the observer. The note is a short explosive "*wick, wick*," said to resemble the note of the little stint, but in my opinion the resemblance is slight.

Ruff (*Machetes pugnax* (L.))—The ruff is an autumn visitor singly or in small numbers. Most occurrences have been noted inland, and probably more birds have been observed about Balgray Dam than in all the rest of our area. Eight have been observed there in one day. One must not infer from this that the ruff shuns the greater part of our district, for to any but the practised field ornithologist the ruff in

autumn is a difficult bird to identify. On the ground it has the appearance and habit of a redshank, though when seen in flight it lacks the conspicuous white back and secondaries of that bird. Then it is a silent bird. I have never heard a ruff utter a note. When ruffs and reeves are together the difficulty is increased. The difference in size between the sexes is so great that to the uninitiated the ruff and the reeve seem to be two species instead of the same. Most of the birds obtained in the area have been shot from amongst flocks of other species, especially golden plover, and it was only when the unknown bird was seen in the bag that inquiry as to its identity was made.

*Common Sandpiper (*Totanus hypoleucus* (L.))—This species is a common summer migrant, arriving from the first week of April onwards. It frequents all kinds of streams and sheets of water, but it has a preference for those with gravelly and sandy banks or margins. By the first week of May the early birds begin to nest. The site chosen is usually on some sloping bank; it may be at the water's edge, or it may be 300 yards away from the water. A hollow scratched in the ground lined with a few pieces of dry grass, dead leaves, or withered herbage receives the four handsome pear-shaped eggs. The young are delightful little creatures and run soon after they are hatched. Before they are able to fly they squat to escape observation as a rule, but if close to water they will take to it readily and dive, coming up some yards away, and remaining motionless by the water's edge or hiding under overhanging herbage. By the end of July the common sandpiper begins to gather in small flocks of ten to twenty birds. The greatest number I have seen in a flock was twenty-four at Balgray Dam. This habit of collecting in small flocks is not mentioned in books on birds, but it is quite characteristic of the bird in late summer. They are then very restless, flying to and fro over the water, calling all the time. From the beginning of August the numbers grow less, till by October all have departed. A common sandpiper after September is a great rarity in our area.

Wood-Sandpiper (*T. Glareola* (J. F. Gmelin))—A rare autumn visitor. One was obtained near Port Glasgow in 1850, one near Campbeltown in 1856, one on Loch Lomond in 1872, and another there in 1878.

Green Sandpiper (*T. ochropus* (L.))—An uncommon visitor, having been seen or obtained about a dozen times in the area, and the bulk of the occurrences have been in East Renfrewshire. With the exception of one record for Rouken Glen in April, the visits have all been in autumn or early winter.

This is a very shy bird flying off on the slightest alarm. It is larger, has longer legs, and stands higher than the common sandpiper. Its dark back contrasts with its white underparts. In flight its white rump is conspicuous, and it then, as the late Professor Newton has remarked, has the appearance of a large house-martin. Indeed, on the wing its actions are decidedly swallow-like. It has a peculiar, wild, and high-pitched note, related to one of the notes of the common sandpiper, but at the same time very distinct from it.

Solitary Sandpiper (*T. solitarius* (Wilson))—An example of this species was recorded by Robert Gray in the "Ibis" (1870, p. 292) as having been obtained some years previously on the banks of Clyde. Some doubt has been cast on this record. The history of the specimen is not entirely satisfactory, but it has been accepted by the best authorities.

*Common Redshank (*T. calidris* (L.))—An abundant species at the coast generally, from autumn to spring, in flocks of a few birds up to several hundreds. In the nesting season it is more local there, though it nests freely close to the shore in some localities. Inland it is common in spring in many districts, while in others, apparently quite suitable, it is scarce or absent. The return to the inland haunts is made in March, varying according to the weather prevailing. Incubation begins about the middle of April, the nest usually being well concealed in a tussock of grass. When the young are hatched the old birds are very noisy and keep up a continuous yelping when one is near their young.

On some parts of the coast redshanks and oyster-catchers breed close together, and the noise they make is deafening if one invades their territory when they have young. The inland nesting grounds are deserted by the end of July, but many birds are seen by lochs and reservoirs till late autumn and occasionally in winter. There is an impression that the redshank is seen more often inland now than was formerly the case, but for thirty years, beyond slight annual variations, I have

been unable to notice any increase in numbers on the Mearns and Eaglesham uplands. It must be borne in mind that a choked drain or an irrigated meadow may mean the presence of a pair or two of redshanks, where there would be none if the water were confined to its proper channel.

Spotted Redshank (*T. fuscus* (L.))—A rare autumn visitor, and it has been observed once in midsummer. All our records for this species in the Clyde area are from East Renfrewshire. One bird was seen at Balgray Dam in October, 1898, and a pair at the same place in September, 1899. A single bird was observed many times at Waulkmill Glen Dam from August to October, 1909. In 1910, also at Waulkmill, one bird was seen on 26th June, while from 14th August till 30th October spotted redshanks were constantly present, mostly at Waulkmill but occasionally at Balgray, the numbers varying from one to three birds. The example noted on 26th June was in full dusky plumage. All the others were either in change or had assumed their light winter dress, though some of them were pretty dark, for instance, the pair in September, 1899, were beautifully spotted. In summer the dusky plumage of this species separates it from all its congeners. In autumn the longer bill and legs and the absence of white on the wings in flight distinguish it from the common redshank, with which it may be confused. It has a very distinct note, an assertive "tew-ee," once heard not likely to be forgotten. Its habits are similar to those of the common redshank, but I once saw one catching small fish, in search of which it waded into the water. At each capture it brought its victim ashore, gave it two or three taps with its bill, and swallowed it.

Greenshank (*T. canescens* (J. F. Gmelin))—A well-known bird of passage appearing by inland waters from the 5th of July till December, and occasionally, in January and February. It has been observed in April at Kilchattan Bay, Bute, but as a rule it is seldom seen in spring. It occurs at the coast as well as inland in autumn, but it is probably more partial to fresh water than to salt. It is noticed nearly every autumn at Balgray Dam. In our area six is about the greatest number seen together at one time, but two or single birds are more frequent. It is one of the wariest of our waders, but it is easily identified by its size (considerably larger than a common redshank), white underparts, and mealy appearance of the

upper parts when the bird is on the ground. In flight it shows a great extent of white on the lower back, but it lacks the conspicuous white secondaries of the common redshank. It has a characteristic note generically allied to those of the common and spotted redshanks. This note was rendered by the late Howard Saunders as "*chee-weet, chee-weet*," and it is quickly uttered.

Red-breasted Snipe (*Macrorhampus griseus* (J. F. Gmelin))—One shot near Lanark, and recorded by Gray, is the only occurrence known. ("Birds of the West of Scotland," p. 316.)

Bar-tailed Godwit (*Limosa lapponica* (L.))—A common species in suitable localities by the shore. It prefers muddy or oozy stretches to clean, sandy, or gravelly shores. It is most common in autumn and spring, frequent in winter, and a few may be seen in midsummer. It is not a shy species, and may often be observed from a moderate distance. It is rare inland, one bird seen at Waulkmill Glen Dam in September, 1909, and one at Balgray Dam in September, 1911, being the only occurrences known. Some of the birds seen in June are in breeding plumage, and an example in this plumage was obtained at Maidens in December, 1912. The greatest number I have seen in one flock was nineteen at St. Ninian's Bay, Bute, on 3rd June, 1898, and I saw about the same number at Troon on 30th September, 1907.

Black-tailed Godwit (*L. belgica* (J. F. Gmelin))—The black-tailed godwit is a scarce visitor mostly in autumn. One was shot on Loch Lomond in 1851, one near Dumbarton in 1867, one at Castle-Semple Loch in 1869, one at Caldwell, 1899, one seen at Balgray Dam, 1899, three at Gad Loch, Lenzie, in May, 1907 (the only spring record), one at Waulkmill Glen Dam in 1909, four at Balgray Dam and two at Troon in 1911, and again two at Troon in 1912. This species is shier than the preceding one, but with a little care one can get sufficiently near to observe it easily through binoculars. I have noticed that when feeding they do not require to raise their long bills from the ground to swallow their food. It passes up between the mandibles from the tip of the bill to the gullet without any apparent raising of the head. The only note I have heard this species utter is a short "*kip, kip*," somewhat like some notes of the black-headed gull.

*Common Curlew (*Numenius arquata* (L.))—An abundant

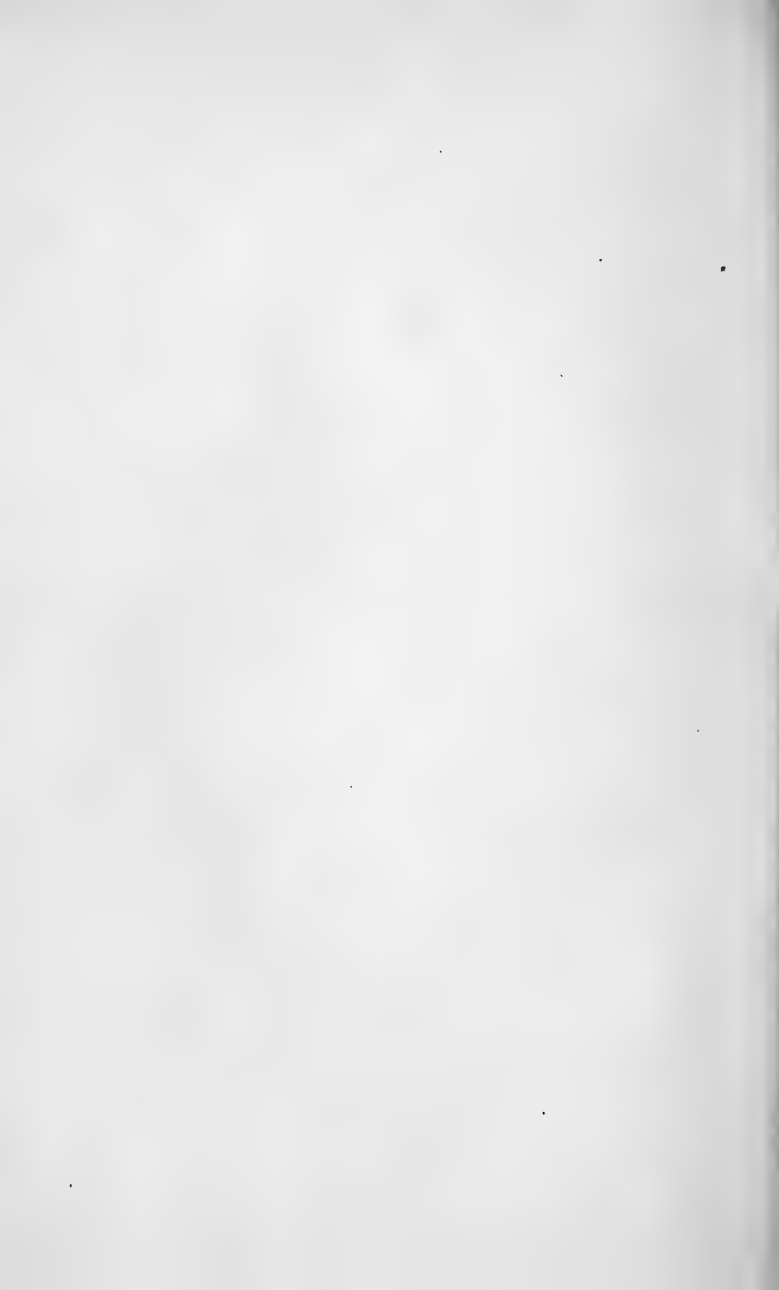
species by the shore most of the year, but less numerous in summer, when most of the birds have retired inland or farther north to breed. The curlew is often heard by night as well as by day passing overhead in the vicinity of Glasgow in every month of the year, though less frequently in the winter months. Many of these passing birds are on their way from the Forth to the Clyde or *vice versa*.

The curlew is a common nesting species on nearly all our moors and rough upland pastures. Where the ground is suitable, as in some parts of Bute, it nests close to the shore. I have seen a nest at Garroch Head just above high-water mark. Nesting begins about the middle of April, the nest with its four eggs, very large for the size of the bird, being placed among grass, heather, or low-growing bog-myrtle. The curlew is a most wary bird, and does not permit of a near approach, but its wild cry of "*courlie, courlie, courlie*" resounding over the wilderness is sweet music to the ornithologist. It has another note like "*whaup, whaup*" which it repeats many times, beginning slowly but finishing rapidly. It is from this "*whaup, whaup*" note that our Scottish name for the bird is derived.

Whimbrel (*N. phæopus* (L.))—A bird of passage passing north from the end of April through May, though a bird or two may be observed in any of the summer months. Fewer birds are noticed on the return passage in autumn than in spring. It may be that the whimbrel is more silent in autumn and consequently not so easily detected, as it is usually by its distinct call "*tetty, tetty, tetty, tet*" that one knows of its presence. It is most often seen near the sea, but it is frequently observed inland. The greatest number I have seen together was seventeen in one flock on 28th April, 1900, resting in a grass field near the shore at St. Ninian's Bay, Bute.









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