

## THE CAMBRIAN LIMESTONE FLORA OF KISHORN, WEST ROSS

By A. A. SLACK AND A. MCG. STIRLING

The frontispiece to Druce's "Flora of West Ross" includes a photograph of the Jurassic limestone pavement at Applecross, and it appears that considerable attention was paid to the rather dull flora of this limestone, but the much more remarkable flora of the Cambrian limestone near Loch Kishorn remained undiscovered until recently. Lightfoot by-passed it by sailing from Gairloch to Glenelg, and from this circumstance we may assume that both Sibbald and Hope were unaware of its interest or, indeed, of its existence. George Don reached Skye but did not linger in West Ross. Hutton Balfour missed Kishorn in his numerous excursions. Prof. Robert Graham visited Applecross, Sheildaig and Loch Carron in 1842, and in 1886 a summer camp (reported by Allan (1887)) was established in the area, but we come down almost to the present century before Druce paid a visit to the Applecross peninsula in 1893.

Druce, in his introduction to "Flora of West Ross", stresses the predominance of infertile rock, claiming that the fucoid beds and limestone at Cnochan offer the best botanising in the vice-county. He does refer to the existence of "a little limestone near the surface" in the neighbourhood of Kishorn, but he clearly had no idea of its extent which makes it the largest limestone area in West Ross and probably the richest botanising ground in the vice-county.

Geologists have visited and mapped the area with some thoroughness, and Peach (1907) gives an account of the Kishorn limestone in relation to the surrounding rocks. The predominant dip of the rocks is very steep, and this has doubtless aided the formation of the "grikes" which are so characteristic of the area and which contribute so much to the establishment of its flora. Analyses of rock samples are given in a memoir of the Geological Survey, "The Limestones of Scotland", from which it is seen that the limestone is of considerable purity and not dolomitised as much as some of the other Cambrian limestones of Scotland's north-west.

Druce's visit of 1893 appears to have been his only contact with Kishorn and he clearly passed it by rapidly on his way to Applecross and back. It seems very likely that Druce passed Kishorn in the dull light of morning hurrying on his way to Applecross, and he only stopped briefly on his return trip to investigate the blaze of yellow produced by *Hypochoeris radicata* near Court-hill. No doubt evening was approaching after the long rough route from Applecross.

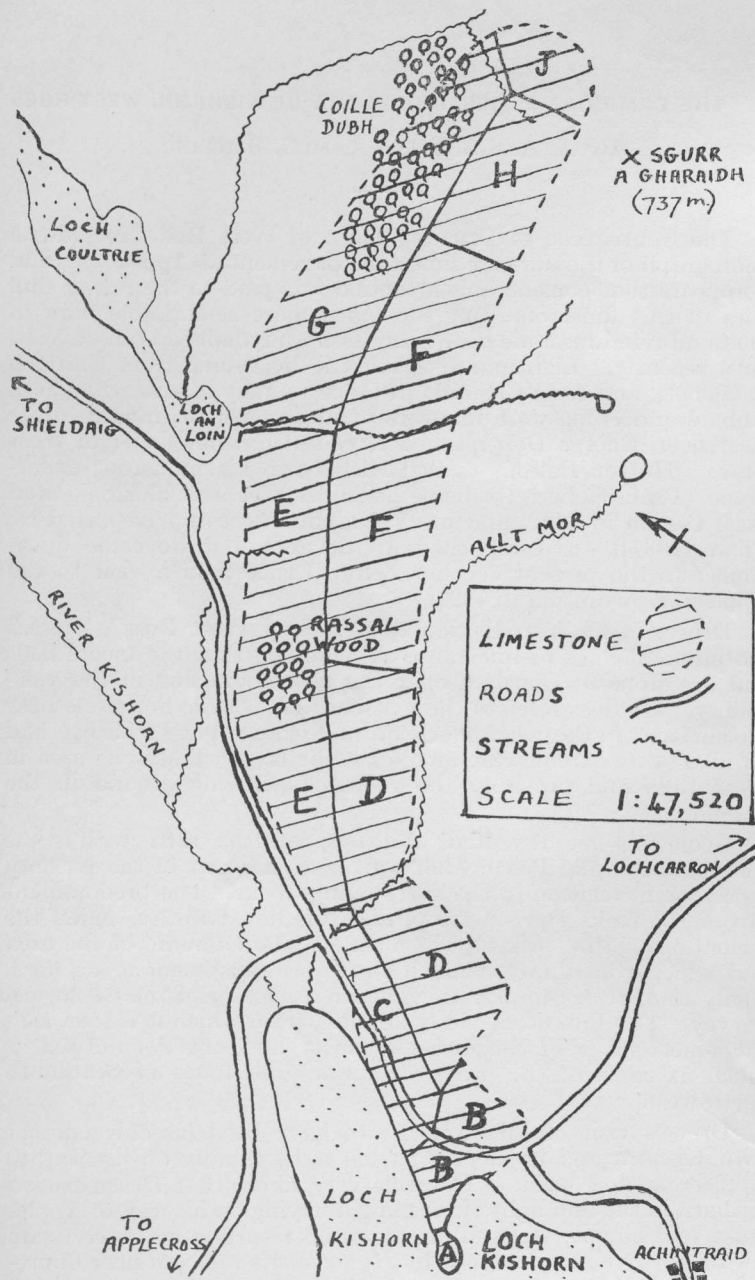


Fig. 1. The Kishorn Limestone Area.

It is interesting to compare the extent of some of these areas of Cambrian limestone. The largest occur just outside the boundaries of Ross, in Skye, near Broadford, where there is an area of about 12 square kilometres of Cambrian limestone, and around Elphin in Sutherland, where again about 12 square kilometres appear. The southern extremity of the latter just crosses the West Ross border. There are two other large areas in Sutherland and some small ones, the large ones being each of about 12 square kilometres, viz., at Durness, and around Inchnadamph. Kishorn is the fifth area in size and is about half the size of the first four, i.e., about 6 square kilometres. There are two other sizeable outcrops of Cambrian limestone in Ross, viz., about 2 square kilometres near Lochan Fada, and rather less near Loch Coulin. The last-mentioned has not been visited by either of the present writers, but it may be now stated that all the other areas exhibit very similar physical appearances and remarkably similar floras. It is hoped at a later date to make comparisons of these floras, but the purpose of the present paper is to describe the Kishorn limestone area.

The nomenclature used in this paper is as follows:—Phanerogams and vascular cryptogams—Dandy (1958); Hepatics—Jones (1958); Mosses—Richards & Wallace (1950).

The Kishorn limestone area in which Cambrian limestone is at or near the surface is a sickle-shape, a little over 5 kilometres in its greatest length from S.W. to N.E. and a little under 2 kilometres at its greatest breadth which is near the south end of Loch an Loin (See Fig. 1).

The flora of this area is remarkably uniform, as it is generously sprinkled with bare limestone outcrops, each one of which is extensively fissured, and on and around each outcrop calcicolous plants such as *Anthyllis vulneria*, *Asplenium trichomanes* and *Polygonum viviparum* occur widely. Nevertheless, there is a general change in flora from south to north, accompanying the average rise in level of the limestone from sea-level in the south to about 450 metres in the north. This change of level is also correlated with a change in land use, there being some cattle farming at the south extremity, many sheep in the middle section, and little human interference in the north. Around Courthill House, near the south end, there have been many introductions, e.g., *Heracleum mantegazzianum* and *Tamus communis* are growing in the woods, and *Erinus alpinus* flourishes on the walls.

For the sake of description the area may be rather arbitrarily divided into 9 sections, A to J, from south to north.

SECTION A. A small tidal area, the southern extremity of which projects above high tide mark as a tidal island. Between the exposures of jagged limestone is a sward composed of *Glaux maritima*, *Armeria maritima* and *Juncus gerardii*.

SECTION B. Largely cattle pasture with boggy patches and considerable areas of scrub wood. It is edged by sea-cliffs up to

six metres high in places, in which sea-caves occur. On the pastures grow some calcicolous plants, e.g., *Helictotrichon pubescens*, *Polygonum viviparum* and *Coeloglossum viride*, while in the wet patches, some of which are quite steep, grow *Pinguicula lusitanica*, *Rhynchospora alba*, *Schoenus nigricans*, *Triglochin palustre*, *Pedicularis palustris* and, in some sluggish water, *Rorippa nasturtium-aquaticum*. The scrub is mainly hazel, but a few plants of *Sorbus aria* occur. In the scrub occur *Listera ovata* and *Epipactis helleborine*. The sea-cliffs have the usual plants such as *Anthyllis vulneraria*, but in addition *Allium vineale* is found in several places. *Asplenium marinum* was only seen once, in a sea-cave. *Geranium lucidum* is another remarkable plant here, occurring on one shore rock.

SECTION C. Includes the policies of Courthill House (now in ruins), and the majority of this section is wooded. It is edged on the west by a sea-cliff which is, however, wooded for much of its length. On the east it opens out to the pastures of Section D. The trees, apart from the numerous introductions around Courthill House, are predominantly hazel and ash. The ground flora is largely composed of *Primula vulgaris* and *Mercurialis perennis*, but in addition there are *Carex remota* in flushes, *Asplenium trichomanes* and *Rubus saxatilis* on rocky outcrops, particularly on the wooded sea-cliff. *Listera ovata* is at Courthill, but the three most noteworthy plants occur on the wooded raised sea-cliff, viz., *Sorbus rupicola*, *Eupatorium cannabinum* in a flushed area, and *Epipactis atrorubens* in several rocky places.

SECTION D. Mainly pasture on which sheep graze. There are, as in all sections, rocky outcrops seamed with fissures or "grikes", but in this section the grassy parts greatly exceed the rocky parts. Grasses are mainly *Sieglingia decumbens*, *Molinia caerulea*, *Festuca ovina*, *Agrostis canina* and *A. tenuis*. On the rocks are *Asplenium trichomanes* and *A. ruta-muraria*, *Mercurialis perennis*, *Primula vulgaris*, *Circaea intermedia* and, here and there, *Dryas octopetala*.

SECTION E. This section merges in the south-east with the pastures of section D, but in the centre of this section is the unique Rassal Wood, which has been acquired by the Nature Conservancy as the only Scottish example of an ash-wood on limestone comparable with those seen in the west of England and in Wales. Rassal Wood contains fissured limestone rock with the same flora as in section D, but no *Dryas octopetala* was seen here. The wood is on a sort of shelf, below which there is a slope down to the road which skirts the west edge of the limestone. This slope is damp with numerous small flushes and streams, and *Carex hostiana*, *Saxifraga aizoides*, *Eriophorum latifolium* and *Schoenus nigricans* are common, while *Linum catharticum* and *Polygonum viviparum* occur abundantly in the drier parts.

SECTION F. This is a continuation northwards of section D, but *Calluna vulgaris* increases here, taking the place of the grassy patches between rocky outcrops. The frequency of rocky outcrops, which is at a minimum on passing from D to F, rapidly increases again on proceeding northwards, and each new outcrop has a tendency to introduce some characteristic plant. *Anthyllis vulneraria*, which has not been seen since leaving the sea coast, now re-appears, then *Polystichum lonchitis* along with *P. lobatum* occupies the "grikes" in the next outcrop, and then *Dryas octopetala* comes in abundance, having been seen only occasionally nearer the sea. In the centre of section F is a particularly rocky area where a sizeable stream flows over waterfalls and eventually descends by a gorge to near the south end of Loch an Loin. This area has a notable amount of *Salix myrsinites*, *Arctostaphylos uva-ursi*, *Juniperus communis*, and here also *Epipactis atrorubens* re-appears. North of this central rocky area extends a wide zone with little grass or heather but much fissured rock, sloping north-west at a fairly gentle angle. Most of the above mentioned plants continue throughout this zone, particularly the *Dryas octopetala* and *Epipactis atrorubens*, but *Salix myrsinites* was not seen again until section H was reached.

SECTION G. This might be entitled Coille Dubh (the Black Wood), which in contrast to Rassal Wood is of Birch instead of Ash. Limestone outcrops with "grikes" are more frequent, and the angle of slope is greater than in Rassal Wood. The birches are sometimes close enough to cast a shade, and *Melica nutans* and *Listera ovata* occur. The other characteristic plants of sections D and F continue. *Dryas octopetala* is abundant, *Polystichum lonchitis* frequent, and *Epipactis atrorubens* not uncommon. *Carex rupestris* appears and becomes frequent and so does *Cirsium heterophyllum*, but *Salix myrsinites* was not seen. An unexpected plant here was *Juncus triglumis* in flushes at the low level of 250 metres.

SECTION H. Continues north from section F, but has a very different appearance, for though mapped as limestone, the rocks of the adjacent Sgurr a' Gharaidh have sent numerous screes to cover the limestone, peat has developed, and rough grassland with *Calluna vulgaris* occurs. There are, however, a few outcrops of the limestone and on each of these *Dryas octopetala* occurs. Streams cross the section above ground, or in many places sink holes swallow them. The largest stream here is near the division between sections H and J. It flows at the surface only when in spate, and a natural limestone arch has been formed at one point in its bed. A little above the arch *Salix myrsinites* re-appears.

SECTION J. Consists largely of two huge outcrops of steep limestone, the uppermost reaching the maximum elevation of the limestone here which is about 450 metres. *Carex rupestris* is abundant along with *Dryas octopetala*, *Epipactis atrorubens*, *Gymnadenia conopsea*, *Anthyllis vulneraria*, etc. A damp area



on the upper outcrop had *Juncus triglumis*. At the extreme north-east edge of the limestone is a huge sink-hole, and here the only specimen of *Botrychium lunaria* encountered was seen.

A few remarks regarding special areas on or near the limestone may conclude this regional account. The gorge descending from the centre of section F to the south end of Loch an Loin, and forming a convenient division between sections E and G, is well worth further exploration. It contains *Viburnum opulus*, *Agropyron caninum*, *Bromus ramosus*, *Galium odoratum*, *Melica nutans*, etc., and its bryophytes would no doubt prove of interest. In a little gorge just off the limestone below section G was seen the only *Ajuga reptans* in this area (*Ajuga reptans* decreases in abundance in north Scotland). Here a collection of bryophytes was made, as summarised later. *Draba incana* and *Allium ursinum*, the latter, surprising at this altitude, was seen on the non-limestone side of the sink-hole at the extreme north-east of the limestone outcrop. It was very noticeable that the steep rocks of Sgurr a' Gharaidh were much wetter and their vegetation more luxuriant than adjacent equally steep limestone rocks. Plants such as *Saxifraga oppositifolia*, *Silene acaulis*, *Saussurea alpina*, *Chamaepericlymenum sueticum*, etc., appeared on the rocks of Sgurr a' Gharaidh just above 450 metres, but on the other hand *Dryas octopetala*, *Epipactis atrorubens* and *Carex rupestris* were absent.

Between limestone rocks in the outcrop areas, a fine red soil with some larger mineral fragments occurs. Two soil samples were taken, one at about 150 metres in Coille Dubh (section G), and the other at about 400 metres in section J. The analyses for these samples are as follows:—

		KISHORN 150 m.	KISHORN 400 m.
Exchangeable	Ca %	0.234	0.717
	Mg %	0.088	0.108
	Na %	0.001	0.006
	K %	0.015	0.044
Loss on ignition	%	4.1	24.5
pH		7.1	7.3
1% Citric soln.	P	5 (deficient)	7 (low)
mg/100g	K	5 (deficient)	22 (high)

The authors were primarily concerned with the flowering plants and ferns of the area, but an attempt was also made to collect at least a representative selection of the bryophytes. For this purpose, three areas were chosen, (a) a gorge where a stream debouched from just below the limestone in section G. Though not actually on the limestone, it was extremely close to it. The second area (b) was the region in Coille Dubh at about 150 metres from which the first soil sample was taken. The third area (c) was the region at the most elevated part of the limestone from which the second soil sample was taken. In addition, bryophytes were collected generally over the limestone. The lists of species which follow are labelled a, b and c where they occurred in

the areas as above, and d where they occurred in the general collection. It is noteworthy that one tuft from the most elevated part of the limestone contained 5 liverworts having a well-defined western distribution in Britain. We wish to acknowledge the help given by Mr. James Dickson in identifying these specimens.

## HEPATICS

HERBERTA HUTCHINSIAE			c
BAZZANIA TRICRENATA			c
ANASTREPTA ORCADENSIS			c
JAMESONIELLA CARRINGTONII			c
PLAGIOCHILA ASPLENIODES	a		
SCAPANIA GRACILIS			d
PLEUROZIA PURPUREA			c
FRULLANIA TAMARISCI		b	d
METZGERIA CONJUGATA	a		
RICCARDIA MULTIFIDA		b	
CONOCEPHALUM CONICUM	a		

## MOSSES

FISSIDENS CRISTATUS		b	d
F. TAXIFOLIUS	a		
DITRICHUM FLEXICAULE			d
DISTICHUM CAPILLACEUM			d
ENCALYPTA STREPTOCARPA			d
HYGROHYPNUM LURIDUM	a		
TORTELLA TORTUOSA	a	b	d
GRIMMIA APOCARPA			d
RHACOMITRIUM LANUGINOSUM		b	
R. ACICULARE	a		
BRYUM PSEUDO-TRIQUETRUM		b	d
MNIUM UNDULATUM			c
M. PUNCTATUM	a		
BARTRAMIA POMIFORMIS			d
PHILONOTIS sp.		b	
BREUTELIA CHRYOACOMA		b	d
NECKERA CRISPA			d
THAMNIUM ALOPECURUM	a		
THUIDIUM DELICATULUM			d
CRATONEURON COMMUTATUM		b	d
CAMPYLIUM sp.			d
ISOTHECIUM MYURUM	a		
I. MYOSUROIDES	a		d
ORTHOTHECIUM RUFESCENS		b	c
HYPNUM CUPRESSIFORME	a		
PTILIMUM CRISTACASTRENSE			d
CTENIDIUM MOLLUSCUM	a	b	d
RHYTIDIADELPHUS LOREUS		b	d
R. TRIQUETRUS	a		d
HYLOCOMIUM SPLENDENS	a		d

Two clumps of *Dryas octopetala* were selected near the south end of section F, and the following flowering plants and ferns were observed in close proximity to them. The southernmost clump is designated S, and the slightly more northern one N:—

ANTHOXANTHUM ODORATUM	N	LOTUS CORNICULATUS	N
BETULA PUBESCENS	N	MOLINIA CAERULEA	N
CALLUNA VULGARIS	S N	PLANTAGO LANCEOLATA	S N
CAREX FLACCA	S N	POLYGALA VULGARIS	N
C. PULICARIS	S	POLYGONUM VIVIPARUM	N
CYSTOPTERIS FRAGILIS	N	POTENTILLA ERECTA	N
FESTUCA OVINA	S N	PRIMULA VULGARIS	N
F. RUBRA	N	PRUNELLA VULGARIS	S
FRAGARIA VESCA	N	SIEGLINGIA DECUMBENS	S N
GERANIUM ROBERTIANUM	N	THYMUS DRUCEI	S N
HELIOTRICHON PUBESCENS	N	VIOLA RIVINIANA	S N

The following flowering plants and ferns were frequently observed to grow in the deeper recesses of the "grikes":—

ASPLENIUM TRICHOMANES	POLYSTICHUM LOBATUM
A. VIRIDE	P. LONCHITIS
CIRSIIUM HETEROPHYLLUM	PRIMULA VULGARIS
HERERA HELIX	SENECIO JACOBÆA
MOLINIA CAERULEA	TROLLIUS EUROPEUS
	VIOLA RIVINIANA

The following flowering plants and ferns were recorded by Druce from Kishorn. In a few cases he gives some idea of the location such as "on the limestone" (but several are obviously from the salt marsh) and the area below Courthill House where he turned aside to find out what bright yellow flower was in abundance there. It was *Hypochoeris radicata*.

STELLARIA HOLOSTEA	GALIUM VERUM
SPERGULARIA RUBRA	GNAPHALIUM ULIGINOSUM
TILIA EUROPAEA	G. SYLVATICUM
GERANIUM MOLLE	ACHILLEA MILLEFOLIUM
OXALIS ACETOSELLA	(var. RUBRA)
SAROTHAMNUS SCOPARIUS	CHRYSANTHEMUM LEUCANTHEMUM
ANTHYLLIS VULNERARIA	TUSSILAGO FARFARA
LATHYRUS MONTANUM	CIRSIIUM ARVENSE
PRUNUS PADUS	(var. HORRIDUM)
RUBUS CORYLIFOLIUS	HIERACIUM IRICUM
ROSA VILLOSA	(on limestone)
EPILOBIUM PARVIFLORUM	HYPOTHOERIS RADICATA
(on limestone)	VERONICA OFFICINALIS
E. OBSCURUM	VERONICA ANAGALLIS-AQUATICA
ANTHRISCUS SYLVESTRIS	ODONTITES VERNA
OENANTHE CROCAT	MENTHA AQUATICA
AETHUSA CYNAPIUM	SCUTELLARIA GALERICULATA
VIBURNUM OPULUS	(var. LITTORALIS)



SALIX REPENS	C. OVALIS
LISTERA OVATA	GLYCERIA MARITIMA
GYMNADENIA CONOPSEA	FESTUCA PRATENSIS (as <i>F. elatior</i> )
COELOGLOSSUM VIRIDE	(on limestone)
IRIS PSEUDACORUS	EQUISETUM FLUVIATILE
JUNCUS GERARDII	(as <i>E. limosum</i> )
SCIRPUS MARITIMUS	PHYLLITIS SCOLOPENDRIUM
CAREX SYLVATICA	(near Kishorn)

The following is a list of the less common flowering plants and ferns seen by us in the limestone area. We are grateful to P. D. Sell and Dr. C. West for identifying the species of *Hieracia* included in the list.

AGROPYRON CANINUM. Not uncommon on shaded limestone rocks. Also on the sea-cliff near Seafeld Farm.

ALCHEMILLA ALPINA

A. FILICAULIS

ALLIUM VINEALE. An unexpected find on low limestone sea-cliffs near Seafeld Farm where it was locally common. A New County Record.

ANTENNARIA DIOICA

ANTHYLLIS VULNERARIA. Frequent on the limestone from the low sea-cliffs to the highest points.

ARABIS HIRSUTA

ARCTOSTAPHYLOS UVA-URSI. Rare.

ARENARIA SERPYLLIFOLIA

ASPLENIUM MARINUM. A few plants in sea-caves near Seafeld Farm.

A. VIRIDE. Very common except on the lowest parts.

BOTRYCHIUM LUNARIA

BRACHYPODIUM SYLVATICUM

BROMUS RAMOSUS

CAREX HOSTIANA

C. LEPIDOCARPA. Frequent in basic flushes on the limestone.

C. RUPESTRIS. There is possibly no place in Britain where this sedge is so abundant as on the higher parts of the Kishorn limestone, where it occupies every crevice of the rocks over large areas but, as usual, flowering sparingly and easily overlooked.

C. SYLVATICA

CIRCAEA INTERMEDIA. Not uncommon in the wooded parts of the area as in Rassal Wood.

CIRSIIUM HETEROPHYLLUM. Frequent in the Coille Dubh area but not noticed elsewhere.

COELOGLOSSUM VIRIDE. Frequent in the limestone pastures near sea-level.

CYSTOPTERIS FRAGILIS. Frequently accompanied *Asplenium viride* on the outcrops.

## DROSERA ANGLICA

DRYAS OCTOPETALA. The upper parts of the limestone support an abundance of this species unsurpassed even by Durness or Inchnadamph. It is interesting to note that Druce knew *Dryas* as a W. Ross plant only at Cnochan Rocks where it just crosses the county boundary.

EPIPACTIS HELLEBORINE. Observed in two places near Courthill and accompanied in one by *E. atrorubens*.

E. ATRORUBENS. Another New County Record. This species was frequent at all levels on the limestone. One magnificent spike close to the road north of Courthill House was two feet in length and had 28 flowers. A few plants with cream-coloured flowers were seen in one place.

ERIOPHORUM LATIFOLIUM. A prominent feature of basic flushes on the limestone.

EUPATORIUM CANNABINUM. Observed only once on wet shaded limestone cliffs near Courthill House. A new County Record.

## EUPHRASIA MICRANTHA

E. CONFUSA

E. SCOTTICA

## GALIUM ODORATUM

G. BOREALE

GENTIANELLA AMARELLA agg. Too young for positive identification.

G. CAMPESTRIS

GERANIUM LUCIDUM. This species was observed in small quantity only on limestone on the shore at the head of Loch Kishorn. Confirms a doubtful record for W. Ross.

## GYMNADENIA CONOPSEA

HELICTOTRICHON PUBESCENS. A prominent feature of the limestone grassland in the lower and middle levels, but also observed occasionally in the upper zones.

## HIERACIUM LINGULATUM

H. HEBRIDENSE

H. AMPLIATUM

H. SHOOLBREDII

H. CHLORANTHUM

H. DURICEPS

H. CALEDONICUM

H. VULGATUM

JUNCUS TRIGLUMIS. This normally alpine species was found sparingly on the limestone at around 250 metres.

JUNIPERUS COMMUNIS. Rare.

LISTERA OVATA. Frequent in the limestone pastures near Courthill. A few plants also occurred on the highest part of the limestone at 450 metres.

MELICA NUTANS. Seen in a few places, but not common.

MYCELIS MURALIS. An unexpected New County Record, several plants growing on an old wall at Courthill House.

PHYLLITIS SCOLOPENDRIUM

PINGUICULA LUSITANICA

PLATANThERA BIFOLIA

POA NEMORALIS

POLYGONUM VIVIPARUM

POLYSTICHUM LOBATUM

P. LONCHITIS. The Holly Fern was frequent in limestone "grikes" from the middle zone upwards.

POPULUS TREMULA

RUBUS SAXATILIS

SALIX MYRSINITES. This willow, which is a prominent feature at Inchnadamph, was found to be quite plentiful on some parts of the limestone over 300 metres. New to v.c. 105.

SAXIFRAGA AIZOIDES

S. HYPNOIDES

SCHOENUS NIGRICANS

SELAGINELLA SELAGINOIDES

SORBUS ARIA *sensu stricto*. A few small trees of this species were growing on the low cliffs near Seafeld Farm. It is possible that they may have been bird-sown from the policies of Courthill House, but the habitat is natural.

S. RUPICOLA. This species is found on limestone rocks in Raasay, and on the Cambrian Limestone at Inchnadamph, thus its discovery on the Kishorn outcrop is not surprising. On the low wooded cliffs near the road north of Courthill House.

THYMUS DRUCEI

TROLLIUS EUROPAEUS

VIBURNUM OPULUS. Observed in the gorge leading to the south end of Loch an Loin.

CHARA VULGARIS. Only one *Chara* was found on the limestone. A specimen from a basic flush below Rassal Wood has been determined by Mr. G. O. Allen to be this species.

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