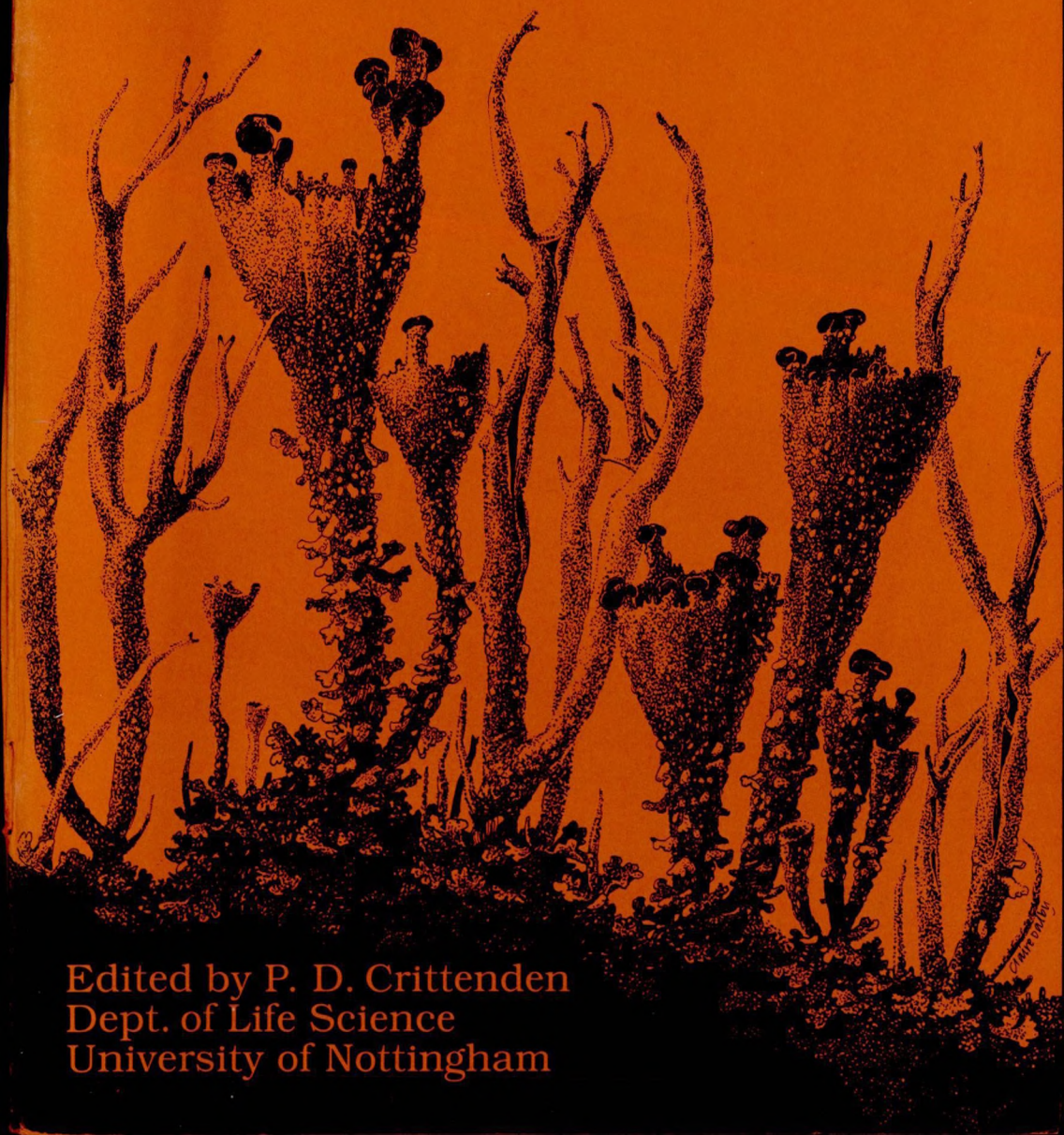


# BRITISH LICHEN SOCIETY BULLETIN

## No. 78 Summer 1996

+ key to non-yellow species of *Rhizocarpon*



Edited by P. D. Crittenden  
Dept. of Life Science  
University of Nottingham

# A PROVISIONAL RE-ASSESSMENT OF THE NON-YELLOW SPECIES OF *RHIZOCARPON* OCCURRING IN THE BRITISH ISLES

## Introduction

The account of *Rhizocarpon* in Purvis *et al.* (1992) mentions a number of species where there are apparent problems *eg R. hochstetteri* and *R. obscuratum*. In the process of carrying out ecological research for my PhD thesis on British montane lichen vegetation it became necessary to study the non-yellow *Rhizocarpon* species in some detail as they constitute an important part of the montane vegetation. Many of my collections failed to fit in with current taxonomic concepts; in particular Feuerer's 1991 revision, which used a rather broad species concept, failed to do justice to the variation I was encountering. It soon became clear that most upland/montane specimens called *R. obscuratum* were in fact *R. lavatum* and that there were also at least two very distinct entities included within *R. hochstetteri*. I have, consequently, paid special attention to these groups, collecting them extensively and subjecting all my collections to a detailed microscopic analysis. I have followed this up with herbarium work in the Natural History Museum and the Royal Botanic Garden, Edinburgh, and I have also seen a small number of collections from Scandinavia (principally in the *R. copelandii* group).

The keys presented here must be considered provisional for three main reasons:-

- i) The genus is relatively poorly represented in the British Isles compared with, for instance, Scandinavia. Many species are rare and it will be necessary to examine foreign material to gain a clearer concept of these.
- ii) More work is needed on a number of problem areas *eg* the *R. copelandii* group.
- iii) Although the main taxonomic entities are established the correct names for them are not. In particular, there are numerous previously published names included in the synonymy of *R. hochstetteri* and it will be necessary to examine the type material of many of these.

In cases of doubt, I have tended to retain species as separate entities rather than "lump" them together as it is easier to combine separately recorded species than it is to separate ones recorded together. Consequently, *R. cinereonigrum* and *R. jemtlandicum* are retained as distinct from *R. badiotrum* and *R. cyclodes*, respectively, although I strongly suspect that they are, at most, only worthy of 'variety' status.

Not included in the key are the lichenicolous *R. advenulum* (on *Pertusaria* spp) and *R. ochrolechia* (on *Ochrolechia parella*).

### Key to the species

- 1      Ascospores 1-septate (occasionally 3-septate or submuriform) ... 2  
        Ascospores 3-septate to eumuriform ..... 18
  
- 2(1)   Ascospores remaining colourless (over-mature spores sometimes becoming brown, but then usually distorted) ..... 3  
        Ascospores soon becoming dark blue-black (occasionally brown) ..  
        ..... 13
  
- 3(2)   Medulla I+ blue; ascospores occasionally becoming 3-septate or submuriform ..... 4  
        Medulla I-; ascospores usually remaining 1-septate ..... 5
  
- 4(3)   Thallus usually C+ red (gyrophoric acid). Epithecium K-, maritime species ..... *R. richardii*  
        Thallus usually C-. Epithecium K+ purple, montane species .....  
        ..... *R. polycarpum*
  
- 5(3)   On basic rock ..... 6  
        On siliceous rock ..... 9
  
- 6(5)   On slightly calcareous rocks (epidiorite, basalt, andesite) in oceanic areas. Rarely on semi-inundated siliceous rocks further east (Scotland). Thallus grey, K-, Pd-. Apothecia flat to slightly convex, to 1.5mm diameter,  $\pm$  inmarginate. Spores 16-18 (-19)  $\times$  7-8 $\mu$ m. Epithecium aeruginose, especially in K.  
        ..... *R. caesium* Fryday in ed.  
        Usually on more strongly basic rock, especially limestone. Thallus white; apothecia smaller. Epithecium olivaceous to brown ..... 7
  
- 7(6)   Epithecium K+ purple ..... *R. chioneum*  
        Epithecium K- ..... 8
  
- 8(7)   Exciple K-. Apothecial disc usually pruinose. Thallus K+ yellow, Pd+ orange (stictic acid) ..... *R. caeruleoalbum*  
        Exciple K+ purple. Apothecial disc not pruinose. Thallus K-, Pd-  
        ..... *R. expallescens*
  
- 9(5)   Ascospores >24  $\mu$ m long, usually becoming brown when old. Paraphysoids with only slightly swollen pigmented cap; remaining  $\pm$  conglutinate in K ..... 10



- Ascospores usually  $<22\text{ }\mu\text{m}$  long, rarely becoming brown when old. Paraphysoids with  $\pm$  distinct, abruptly swollen pigmented caps;  $\pm$  separating in K ..... 11
- 10(9) Thallus grey-brown; Usually K-, Pd- (stictic acid absent). On exposed upland/montane siliceous boulders. ....  
*R. colludens* (Nyl.) Fryday in ed.  
 Thallus red-brown; Usually K+ yellow, Pd+ orange (stictic acid). Restricted to high altitude .....  
*R. colludens* v. *rufotratum* Fryday in ed.
- 11(9) Thallus thin, olivaceous-brown,  $\pm$ continuous; K-, Pd-. Apothecia with thin, persistent exciple. Ascospores  $19\text{-}21 \times 9\text{-}11\text{ }\mu\text{m}$ . Epithecium brown. Frequent oceanic species, becoming scarce in Scotland although extending as far north as Knoydart. Usually on boulders in woodlands but becoming upland/montane in SW England (Dartmoor) and SW Ireland (Brandon Mountain). ....  
*R. oceanicum* Fryday in ed.  
 Thallus white, grey or brown, areolate to slightly warted. Apothecia with thicker exciple or occasionally  $\pm$ immarginate. Ascospores  $14\text{-}16\text{-}(18) \times 7\text{-}8\text{ }\mu\text{m}$ . Epithecium brown or blue-black. Upland or montane species ..... 12
- 12(11) Thallus pale grey to brown, areolate; either K+ red, Pd+ yellow (norstictic acid), K+ yellow, Pd+ orange (stictic acid) or K-, Pd- (no substances). Epithecium blue-black (occasionally olivaceous-brown); paraphysoids with distinct, pigmented cap and separating in K .....  
*R. hochstetteri*  
 Thallus white or pale grey, warted-areolate, K+ red, Pd+ yellow (norstictic acid). Epithecium bright blue-black; paraphysoids less distinctly capitate and only slightly separating in K. On disused metal-mine spoil, montane rocks and coastal shingle. ....  
*R. aff. cinereovirens*
- 13(2) Medulla I+ blue; ascospores  $12\text{-}16 \times 6\text{-}8\text{ }\mu\text{m}$ ; exciple K+ purple .....  
*R. simillimum*  
 Medulla I-; ascospores larger, exciple K+ purple or K- ..... 14
- 14(13) Epithecium K+ purple ..... 15  
 Epithecium K- ..... 16
- 15(14) Thallus K-, Pd- (no substances). Sub-montane; usually on semi-inundated boulders in streams or the margins of lakes .....  
*R. badioatrum*

- Thallus K+ yellow, Pd+ orange (stictic acid). Apparently restricted to high altitude, usually associated with areas of prolonged snow-lie.....*R. cinereonigrum*
- 16(14) Thallus of plane to convex white areoles; K+ red, Pd+ yellow (norstictic acid). Exciple K+ purple. Usually on shaded rocks or sides of boulders at intermediate altitudes. ....*R. copelandii*  
Thallus grey to brown; K+ yellow, Pd+ orange (stictic acid). Exciple K-. Usually on exposed mountain tops. .... 17
- 17(16) Thallus usually grey, areoles up to 1mm diameter. Epithelial pigment diffuse. Apothecia ±innate, flat to slightly convex, exciple indistinct. Usually on tops of exposed montane boulders. ....  
.....*R. ?cyclodes* Hellb. ex. Th. Fr.  
Thallus usually brown, areoles up to 1.5mm diameter. Epithelial pigment less diffuse. Apothecia sessile remaining flat with a persistent, thick, raised exciple. Usually associated with areas of prolonged snow-lie. ....*R. jemtlandicum*.
- 18(1) Ascospores predominantly 3-septate (if medulla I+ blue see 2a) ..  
..... 19  
Ascospores usually with some longitudinal septa ..... 20
- 19(18) Thallus orange to rust-red. Apothecia umbonate to gyrose. Usually on metal-rich rocks. ....*R. oederii*  
Thallus grey. Apothecia smooth. On montane rocks  
.....*R. submodestum* (Vainio) Vainio
- 20(18) Ascospores dark brown, asci 2-spored .....*R. geminatum*  
Ascospores colourless ..... 21
- 21(20) On calcareous rocks ..... 22  
On siliceous rocks ..... 23
- 22(21) Thallus grey to white. Exciple at most slightly pruinose, disc not pruinose. Ascospores strongly muriform (3-9 transverse, 1-2 longitudinal septa), 20-50 x 10-24µm .....*R. petraeum*  
Thallus chalk-white. Exciple thickly pruinose, disc usually pruinose. Ascospores less strongly muriform (3-4 transverse, 1(-2) longitudinal septa), 15-30 x 9-16µm .....*R. umbilicatum*
- 23(21) Thallus continuously, finely isidiate-sorediate (blastidia). On metal-rich rocks. Apothecia rare .....*R. furfurosum*  
Thallus otherwise. Apothecia usually present ..... 24

24(23)	Asci 2-spored .....	<i>R. subgeminatum</i>	
	Asci 8-spored .....		25
25(24)	Medulla I+ blue. Epithecium usually K+ purple; exciple K+ purple .....	<i>R. distinctum</i>	
	Medulla I- .....		26
26(25)	Epithecium K+ purple. Apothecia innate. On semi-inundated rocks .....	<i>R. amphibium</i>	
	Epithecium K- .....		27
27(26)	Ascospores submuriform, usually <25µm long .....		28
	Ascospores eumuriform, usually >25µm long .....		29
28(27)	Ascospores (16-)18-22 x (10-)11-13µm. Length/breadth ratio 1.5- 2.0. Thallus indistinct, K-, Pd- (stictic acid absent). Rare upland/ montane species .....	<i>R. postumum</i>	
	Ascospores 19-28 x 10-12. Length/breadth ratio 1.75-2.75. Thallus well-developed, K+ yellow, Pd+ orange or K+ red, Pd+ yellow (stictic or norstictic acids), common species of rocks and pebbles . .....	<i>R. reductum</i> Th. Fr.	
29(27)	Ascospores 33-50 x 12-17µm. Length/breadth ratio 2.0-3.0 .....	<i>R. lavatum</i>	
	Ascospores usually <30µm long. Length/breadth ratio 1.5-2.0 .....		30
30(29)	Thallus brown, granular-areolate. Ascospores 22-33 x 11-19µm. Only brown pigments present internally; epithecium K+ grey (at least in places) .....	<i>R. ?anaperum</i> (Vainio) Vainio	
	Thallus grey, cracked-areolate. Ascospores 17-36 x 11-15µm. Brown and blue pigments present internally; epithecium K+ aeruginose (at least in places), exciple edge K+ aeruginose .....	<i>R. sublavatum</i> Fryday in ed.	

### Notes.

*R. amphibium* - new to the British Isles. The specimen from Caenlochan provisionally placed here by Purvis *et al* (1992:539) belongs in *R. lavatum*. However *R. amphibium* has subsequently been recorded from NE Scotland (Glen Quoich) and NE England (Upper Teesdale).

*R. ?anaperum* - new to the British Isles. A number of collections from damp north-facing corries and near areas of late snow-lie in Scotland are provisionally placed here. This entity has also been recorded from Snowdonia and four disused metal-mines in mid-Wales. Feuerer (1991) referred this

## Summary of Important Distinguishing Characters

a - spore septation	d - epithecium K+ p	g - norstictic acid
b - spore colour	e - exciple K+ p	h - stictic acid
c - medulla I+ b	f - gyrophoric acid	i - calcareous rock

Species	a*	b†	c	d	e	f	g	h	i
<i>R. badioatrum</i>	1	d	-	+	+	-	-	-	-
<i>R. cinereonigrum</i>	1	d	-	+	+	-	-	+	-
<i>R. copelandii</i>	1	d	-	-	+	-	+	-	-
<i>R. ?cyclodes</i>	1	d	-	-	-	-	-	+	-
<i>R. jemtlandicum</i>	1	d	-	-	-	-	-	+	-
<i>R. simillimum</i>	1	d	+	-	+	-	±	±	-
<i>R. caeruleoalbum</i>	1	c	-	-	-	-	-	±	+
<i>R. "caesium"</i>	1	c	-	-	-	-	-	-	±
<i>R. chioneum</i>	1	c	-	+	+	-	-	+	+
<i>R. cinereovirens</i>	1	c	-	-	-	-	+	-	-
<i>R. "colludens"</i>	1	c	-	-	-	-	-	-	-
<i>v. "rufoatrum"</i>	1	c	-	-	-	-	-	+	-
<i>R. expallescens</i>	1	c	-	-	+	-	-	-	+
<i>R. hochstetteri</i>	1	c	-	-	-	-	±	±	-
<i>R. "oceanicum"</i>	1	c	-	-	-	-	-	-	-
<i>R. polycarpum</i>	1	c	+	+	+	±	-	±	-
<i>R. richardii</i>	1	c	+	-	-	±	-	±	-
<i>R. oederi</i>	3	c	-	-	-	-	-	+	-
<i>R. submodestum</i>	3	c	-	-	-	-	-	+	-
<i>R. amphidium</i>	sm	c	-	+	+	-	-	-	-
<i>R. distinctum</i>	sm	c	+	+	+	±	-	±	-
<i>R. postumum</i>	sm	c	-	-	-	-	±	-	-
<i>R. reductum</i>	sm	c	-	-	-	-	±	+	-
<i>R. geminatum</i>	m	d	-	+	+	-	-	±	-
<i>R. ?anaperum</i>	m	c	-	-	-	-	-	-	-
<i>R. petraeum</i>	m	c	-	-	-	-	-	+	+
<i>R. furfurosum</i>	m	c	-	-	-	-	-	+	-
<i>R. lavatum</i>	m	c	-	-	-	-	-	-	-
<i>R. subgeminatum</i>	m	c	-	-	+	-	-	±	-
<i>R. "sublavatum"</i>	m	c	-	-	-	-	-	-	-
<i>R. umbilicatum</i>	m	c	-	-	-	-	-	+	+

\* sm = submuriform, m = eumuriform

† d = dark, c = colourless

species to *R. obscuratum* but even allowing for the previous concept of that species it is clearly morphologically and anatomically distinct.

***R. badioatrum*.** As suggested in Purvis *et al* (1992) records of *R. badioatrum* from the Cairngorms (in particular from the late-lying snow bed in Ciste Mhearad (Gilbert and Fox, 1985) belong in *R. jemtlandicum*. This accounts for the reports of stictic acid in British specimens of *R. badioatrum* (also mentioned by Purvis *et al*) although it is possible that some records are of *R. cinereonigrum*.

*R. badioatrum* is most frequently a species of siliceous rocks in or on the edge of upland-montane lakes and streams. Two distinct entities are recognised within *R. badioatrum* although only one has been recorded from the British Isles.

***R. caeruleoalbum*** - not studied.

***R. "caesium"*** - new to science. The record of *R. expallescens* from Ben Hope (Gilbert and Fox, 1986; Purvis *et al*, 1992) refers to this species. It most frequently occurs on slightly basic rocks in hyper-oceanic areas where it can be locally common.

***R. chioneum*** - not studied.

***R. cinereonigrum*** - new to the British Isles. Separated from *R. badioatrum* primarily by the presence of stictic acid and its ecology - *R. cinereonigrum* occurs only at very high altitudes, most often in the vicinity of areas of prolonged snow-lie. It probably only deserves recognition as a variety of *R. badioatrum*.

***R. aff. cinereovirens*.** The type of *R. cinereovirens* (in BM) is a norstictic acid containing strain of *R. hochstetteri*. The description in the key refers to specimens from disused metal-mine spoil in Wales and Scotland which differ from *R. hochstetteri* in morphology and anatomy and for which it will probably be necessary to find a new name.

***R. "colludens"*** - new combination, resurrected from synonymy. This is a common upland/montane species of siliceous rocks usually called *R. hochstetteri* by British and Scandinavian lichenologists. However, it differs from that species by its much larger spores and less distinctly capitate paraphysoids that remain  $\pm$ conglutinate in K. It has a grey-brown thallus and lacks stictic acid. The v. "*rufoatrum*" (new to science) differs in the



presence of stictic acid as well as the thicker red-brown thallus and its habitat of high altitudes only.

***R. concentricum*** - see *R. petraeum*.

***R. copelandii***. The holotype of this species (in L) has a thallus composed of dispersed, grey, convex areoles and a K+ purple exciple. Timdal & Holten-Hartwig (1988) have a much broader concept of this species, including collections closer to *R. jemtlandicum*. These are here provisionally referred to *R. cyclodes* (see below).

***R. ?cyclodes*** - resurrected from synonymy (see *R. copelandii*). This appears to be the earliest available name for those specimens included in *R. copelandii* by Timdal & Holten-Hartwig (1988) but which have a  $\pm$ continuous, areolate thallus and lack a K+ purple exciple. However, its separation from *R. jemtlandicum* is in need of further investigation. It is not rare at high altitudes in the Scottish Highlands although it has in the past been confused with *R. jemtlandicum*. British specimens are all morphologically similar and contain stictic acid. However, even after the removal of *R. copelandii* s. str., Scandinavian specimens are morphologically more varied and some also contain norstictic acid in place of stictic acid. The complex warrants further study.

***R. distinctum*** - not studied. *R. distinctum* has a red-brown, K+ purple epihymenium. However, I have a collection (from East Lothian) which has a blue-black, K+ blue epithecium - although the exciple is red-brown, K+ purple. As all other characters coincide with those of *R. distinctum* I have no hesitation in placing it in this species.

***R. expallescentis***. This is an extremely rare species recorded in the British Isles only from Coire Cheap (Ben Alder) and Caenlochan. The record from Ben Hope (Gilbert & Fox, 1986; Purvis *et al.*, 1992) is referable to *R. "caesium"*, whereas all other records, including those from disused Welsh metal-mines, belong in *R. hochstetteri* s. str.

***R. furfurosum*** - not studied.

***R. geminatum*** - not studied.

***R. hochstetteri***. The description in Purvis *et al.* (1992) reflects the confusion surrounding this species in the British Isles, it being a composite description of *R. colludens* and *R. "oceanicum"*. The description of this species in Timdal & Holten-Hartwig (1988) refers to *R. "colludens"*. I have been

unable to locate the type specimen of *R. hochstetteri* but from the original description (Körber, 1861) and its location, along with the descriptions and opinions of subsequent German/Austrian authors (Poelt and Vezda, 1981; Wirth, 1987; 1995; Feuerer, 1987) I am confident that my concept of the species coincides with that of Körber. Specimens from disused mine spoil in mid-Wales with a pale grey thallus, appear to have a shallower thecium and be more intensely pigmented internally. These may represent a distinct taxon.

***R. jemtlandicum***. In the British Isles this species is confined to rocks in the vicinity of areas of prolonged snow-lie. Most previous records from the British Isles refer to the closely related *R. ?cyclodes*. *Rhizocarpon jemtlandicum* is morphologically and ecologically distinct from *R. ?cyclodes* although anatomically it differs in only minor respects. They are here retained as separate species pending a more detailed investigation of this complex.

***R. lavatum***. This species is very variable morphologically but is anatomically well defined by its large muriform spores and thick, tumid exciple. It is not restricted to lake and stream sides as stated by Purvis *et al*, but is far more widely distributed, being frequent on damp rocks throughout the Scottish Highlands and elsewhere. The ochraceous tinge to the thallus also mentioned by Purvis *et al* is only rarely encountered. The earliest available name for this species is *R. obscuratum* (see note under that species). However as this would cause considerable confusion it will be necessary to preserve the name *R. lavatum* by a formal rejection of *R. obscuratum* (see below).

***R. oederi*** - not studied.

***R. obscuratum***. The type material of *Lecidea petraea* var. *obscurata* Ach., upon which this name is based, is a small form of the species currently known as *R. lavatum*. As *R. obscuratum* has been used for *R. reductum* (see below) as well as small forms of *R. lavatum*, it seems wisest to reject the name altogether.

***R. "oceanicum"*** - new to science. This species is closely related to *R. hochstetteri* and many British records of that species belong here.

***R. petraeum*** - not studied. Feuerer (1991) showed this to be the correct name for the species previously known as *R. concentricum*.

***R. plicatile***. The syntype of *R. plicatile* (in BM) collected by Leighton from

Cader Idris (N. Wales) is small and in poor condition with only two immature apothecia. However, detailed anatomical notes were made by P W James in 1960 and the specimen was subjected to tlc in 1983 and found to contain stictic acid and atranorin. It is also sorediate. There is an annotation in pencil on the herbarium sheet (?Lamb) querying its placement in *Rhizocarpon* and an undated determination of *R. obscuratum* by Feuerer; who does not treat *R. plicatile* in his most recent work (Feuerer, 1991). The specimen is referable to a crustose *Stereocaulon* species very close to *S. tornense* (but with muriform rather than 3-septate spores) known from a number of localities in Scotland and one in North Wales. It was previously believed to be undescribed. Most other British collections named *R. plicatile* are referable to *R. reductum*. The position of the non-British *R. rubescens*, usually considered a synonym of *R. plicatile*, is less clear. I have not seen the type of this species but A Schade, in a letter to A L Smith housed with the type of *R. plicatile*, considers *R. coniopsoideum* to belong in *R. rubescens*. As *R. coniopsoideum* is a synonym of *R. reductum* it is probable that the name *R. rubescens* refers to the norstictic acid containing strain of *R. reductum*.

***R. polycarpum*** - not studied. The chemistry of *R. polycarpum* and *R. richardii* is reported as *R. richardii* - stictic acid, gyrophoric acid or both; *R. polycarpum* - stictic acid or none. However, Mackenzie Lamb (1940) cites a collection from Somerset with a C+ red thallus and K+ purple epithecium (ie *R. polycarpum* with gyrophoric acid) and I have also collected similar specimens from Glen Coe. Two further collections from maritime rocks (Islay and Harris) have dark ascospores, a K+ purple epithecium and contain stictic and gyrophoric acid (ie *R. richardii* with a K+ purple epithecium). Laundon (1986) has shown that spore colour is very variable in *R. richardii* and these apparant intermediates reduce the distinction between the two species considerably. However, they are here retained as distinct entities pending a more critical investigation of this group.

***R. postumum*** . The single British gathering of this species mentioned in Purvis *et al* (1992) is referable elsewhere; possibly to an apparently undescribed species known from two other collections, also from Ben Lawers (*cf* Gilbert *et al*, 1988 - as *R. sp* 'A'). However there are two specimens of *R. postumum* in BM, from Ben Lawers (Holl 1886) and Caithness (Willey 1905) and I have also collected this species more recently in West Sutherland. The type collection (in H-NYL) is also from Scotland.

***R. reductum*** - resurrected from synonymy. This entity has usually been called *R. obscuratum*. (see note under that name). The only recent work

to recognise *R. reductum* as a distinct species is Foucard (1990).

*R. richardii* - not studied. See note under *R. polycarpum*.

*R. simillimum* - not studied.

*R. subgeminatum* - not studied. This species appears to be fairly frequent at low altitudes in the Scottish Highlands where it usually occurs on the sloping upper sides of siliceous boulders. British specimens are reported as containing no lichen substances (Purvis *et al* 1992). However, Timdal & Holten-Hartwig (1988) report four chemotypes among Scandinavian specimens, which are also morphologically and anatomically rather varied. The complex clearly warrants further study, particularly with reference to the K+ purple exciple which does not appear to have been mentioned in previous studies.

*R. "sublavatum"* - new to science. Often occurs with *R. lavatum* on damp, montane rocks. In this situation *R. lavatum* is often the host to lichenicolous fungi but *R. sublavatum* always remains uninfected. It most closely resembles *R. anaperum* and its separation from that species and *R. lavatum* relies upon a number of small details. However all three species often occur together when they remain morphologically distinct.

*R. submodestum* - new to the British Isles. Not studied. The species with 3-septate spores are poorly understood. Both British collections (Glas Moal and Aonach Mor) contain stictic acid. Feuerer (1991) included this species in *R. obscuratum*.

*R. umbilicatum* - not studied.

**Acknowledgements:** I wish to thank the University of Sheffield for awarding me a research scholarship to study the British montane lichen vegetation and the British Ecological Society for a grant to cover expenses for herbarium visits to bring this work to its present level. I also wish to thank the curators of BM and E for allowing me free access to their collections and the curators of H, UPS and L for the loan of specimens.

#### References

- Feuerer, T (1987). Revision Schleswig-Holsteinischer Funde der Flechtengattung *Rhizocarpon*. *Kierler Notizen Pflanzenkunde Schleswig-Holstein Hamburg* 19: 85-100.
- Feuerer, T (1991). Revision der europäischen Arten der Flechtengattung *Rhizocarpon* mit nichtgelben Lager und vielzelligen Sporen. *Bibliotheca Lichenologica* 39: 1-218.

- Foucard, T (1990). *Svensk Skoplavs Flora*. Stockholm, Interpublishing.
- Gilbert, O L & Fox, B W (1995). Lichens of high ground in the Cairngorm mountains, Scotland. *Lichenologist* **17**: 51-66.
- Gilbert, O L & Fox B W (1986). A comparative account of the lichens occurring on the geologically distinct mountains of Ben Loyal, Ben Hope and Foinaven. *Lichenologist* **18**: 79-93.
- Gilbert O L, Coppins B J & Fox B W (1988). The lichen flora of Ben Lawers. *Lichenologist* **20**: 201-243.
- Körber, G W (1861). *Parerga Lichenologica*. Breslau.
- Laundon, J R (1986). Studies in the nomenclature of British lichens II. *Lichenologist* **18**: 169-177.
- Leighton, W A (1879). *The Lichen Flora of Great Britain, Ireland and the Channel Islands*. 3rd ed. Shrewsbury.
- Mackenzie Lamb, I (1940). Lichenological Notes from the British Museum Herbarium - IV. *Rhizocarpon* sect. *Catocarpon* in the British Isles. *Journal of Botany* **78**: 129-138.
- Poelt, J & Vezda, A (1981). Bestimmungsschlüssel europäischer Flechten. Ergänzungsheft II. *Bibliotheca Lichenologica*. **16**: 1-390.
- Purvis, O W, Coppins, B J, Hawksworth, D L, James, P W & Moore, D M (1992). *The Lichen Flora of Great Britain and Ireland*. London: Natural History Museum.
- Timdal, E & Holten-Hartwig, J (1988). A preliminary key to *Rhizocarpon* in Scandinavia. *Graphis Scripta* **2**: 41-54.
- Wirth, W (1987). *Die Flechten Baden-Württembergs*. Stuttgart, E. Ulmer.
- Wirth, W (1995). *Die Flechten Baden-Württembergs*. Stuttgart, E. Ulmer.

Alan Fryday

*Note added in proof*

*R. grande* (Flotow) Arnold. This species has recently been collected from the British Isles (Field Meeting in Clwyd - this volume). I have not seen this specimen and cannot comment on it. In the key *R. grande* will appear as *R. geminatum* but it is readily separated from that species by its 8-spored asci, smaller ascospores, I+ blue medulla, C+ red thallus and K- epithecium (K+ purple in *R. geminatum*).