Short Notes

DIPHASIASTRUM ALPINUM (L.) HOLUB IN HARRIS

It is strange that the alpine clubmoss, *Diphasiastrum alpinum* (L.) Holub, which is widespread in neighbouring parts of the Scottish mainland and Inner Hebrides, should be hitherto unrecorded for v.c. 110. A search for it and other rarities covering ten years and many miles led to the discovery in July 1977 of a small thriving colony at an altitude of 480m, GR 19/163.081, just below the outlet of the lochan which lies on the col between Sgurr Scaladale and Tomnaval. The plants were in short turf on the gently inclined grassy slope a little above the steep plunge into Scaladale. They were found near the end of a day spent searching the Clisham range, and the little time left to negotiate the drop down to the track prevented prolonged search for further colonies. A voucher specimen is in **LTR.**

J. T. B. & D. BOWMAN

SENECIO CINERARIA DC. × *S. ERUCIFOLIUS* L. IN E. KENT

Senecio cineraria DC. (recently reduced by Chater (1974) to a subspecies of *S. bicolor* Tod., but for convenience referred to here by the more familiar specific name) is well known as a naturalized alien in Britain and Ireland. Most localities are near coastal resorts where it has spread from gardens to adjacent cliffs. In some of these, hybrids with the native *S. jacobaea* L. have arisen (Benoit *et al.* 1975). However, there do not appear to be any reports of hybrids between *S. cineraria* and other native species closely related to *S. jacobaea*. This is hardly surprising as the localities are all too dry to support *S. aquaticus* Hill and are outside the areas where *S. erucifolius* L. is of frequent occurrence. These three native species all have $2n = 40$, the same number as *S. cineraria*, and are placed in Sect. *Jacobaea* (Miller) Dumort. *S. cineraria* belongs to Sect. *Incanae* (DC.) O.Hoffm., but sectional differences are no barrier to hybridization in the genus: the commonest hybrid *Senecio* in south-eastern England is *S. squalidus* L. (Sect. *Jacobaea*) × *S. viscosus* L. (Sect. *Senecio*), another instance of an opportunity for hybridization created by the spread of an alien species into the area already occupied by a native one.

The extensive population of naturalized *Senecio cineraria* south of Deal in E. Kent, v.c. 15, is exceptional. The habitat is not a cliff but a level area of pebbles lying inland of the present-day shingle beach, and the native species present include *S. erucifolius*. *S. cineraria* × *S. jacobaea* is already well known there, although v.c. 15 is not among the vice-counties listed for this hybrid by Benoit *et al.* (1975).

The first discovery of *S. cineraria* × *S. erucifolius* was made in this vicinity by B. Wurzell on 19th June, 1978, south of Walmer. He found a population including *S. cineraria, S. erucifolius, S. jacobaea* and plants with both whitish tomentum, a character which could only be inherited from *S. cineraria*, and short stolons, indicating that *S. erucifolius* must be the other parent. At that date the plants were not flowering. Mr Wurzell mentioned his discovery to me briefly in a letter, without indicating the precise locality. On 11th August, 1978, I happened to be in the same general area and searched for the new hybrid in what subsequently turned out to be a different place. Here *S. cineraria* and *S. erucifolius*, but not *S. jacobaea*, were present and I soon found a single flowering hybrid specimen, one branch of which was collected. This plant lacked stolons but is demonstrably of the same parentage as Wurzell's; further observation will be necessary before it can be stated either that stolons die back early or that the hybrid exists in nothomorphs both with and without them.

In spite of this uncertainty I believe it practicable to describe the new hybrid, typifying it by my August gathering. I propose to name it in honour of A. P. Paterson, curator of the Chelsea Physic Garden, whose article (Paterson 1978) in praise of the exotic plants established on this beach, including *S. cineraria* and unspecified hybrids, was published coincidentally in August 1978.

Senecio × **patersonianus** hybrida nova e *S. cineraria* DC. et *S. erucifolio* L. exorta. Ab illo corymbo strictiore, bracteis exterioribus multum longioribus, achaeniis in costis pilosis, ab hoc tomento et foliis obtusilobis differt.

Planta stolones aut breves aut nullos emittens. Caudex aliquantum lignosus tantummodo in parte inferiore ramosus tomento albido munitus. Folia caulinaria ovato-oblonga parva (5 × 2 cm) profunde regulariterque pinnatifida, infra albido-tomentosa supra alboviridia araneo-hirsuta, lobis inferioribus reductis caulem amplectentibus ceteris ovatis tenuiter pinnatifidis lobulis obtusis. Corymbi plani densi ramis inferioribus arcte ascendentibus modo apicem versus ramosis. Involucra 5 mm tomentosa cinerea crassa campanulata, bracteis lanceolatis, exterioribus plerumque 3, quam interioribus circa triplo brevioribus. Ligulae circa 12, laete flavae. Achaenia in costis breviter pilosa.

HOLOTYPUS: England: E. Kent: near Kingsdown, on shingle west of present-day beach, with *S. cineraria* and *S. erucifolius*. 11th August, 1978. *R. M. Burton* (**BM**)

The tomentum makes the hybrid closer in general appearance to *S. cineraria*, although when the two plants are placed side by side it is obviously less dense than that of the latter species. The two have leaves of similar shape but those of the hybrid are of a much thinner texture. The achenes of the hybrid have hairy ribs, like those of *S. erucifolius*; in *S. cineraria* they are glabrous. Separation from *S.* × *albescens* Burbidge & Colgan (*S. cineraria* × *S. jacobaea*) is more difficult and is best effected by an examination of the outer bracts. In *S. erucifolius* these are about half as long as the inner bracts, a character which in combination with the very small outer bracts of *S. cineraria* produces a length about one-third of that of the inner bracts in the new hybrid. In *S. jacobaea* the outer bracts are also about one-third as long as the inner, so that those of *S.* × *albescens* are proportionately smaller.

The achenes of the type specimen appear to be sterile, but this character would be better observed later in the year when they have had more time in which to mature.

REFERENCES

BENOIT, P. M., CRISP, P. C. & JONES, B. M. G. (1975). *Senecio* L., in STACE, C. A., ed. *Hybridization and the flora of the British Isles*, pp. 404–410. London.

CHATER, A. O. (1974). Taxonomic and nomenclatural notes on *Senecio* L. *Bot. J. Linn. Soc.*, **68**: 272–76.

PATERSON, A. P. (1978). Exotics on a Kentish beach. *Country Life*, **164**: 556–57.

R. M. BURTON

CHROMOSOME NUMBERS OF BRITISH PLANTS, 6

		Grid Reference and locality
Galium boreale L.	$2n=44$	35/843.284 Cronkley Fell, Teesdale, N.W. Yorks., v.c. 65
	$2n=44$	35/814.302 Widdybank Fell, Teesdale, Durham, v.c. 66
	$2n=44$	35/904.279 Wynch Bridge, Teesdale, Durham, v.c. 66
	$2n=44$	27/590.411 Creag an Lochain, Mid Perth, v.c. 88

The only previous report of the chromosome number of the British material of this species gave counts of $2n=44$ for plants from Teesdale and Lough Derg, Eire (Rahn 1961). These counts agree with practically all those reported from Continental material.

REFERENCE

RAHN, K. (1961). Cytological and taxonomical studies of *Galium boreale* and allied species (a preliminary note). *Bot. Tidsskr.*, **56**: 351–354.

A. DALE

ANOTHER BRITISH LOCALITY FOR *CAREX MURICATA* L. *SENSU STRICTO*

Nelmes (1947) distinguished *Carex muricata* L. *sensu stricto*, of which the type-specimen is in **LINN**, from the sedge known as *C. pairaei* F. W. Schultz. The former is a calcicolous plant of northern and eastern Europe; the latter largely replaces it in the south and west and is calcifuge. *C. pairaei* is frequent in Britain wherever there are acid sands or gravels, but especially in south-western England and in western Wales, whereas *C. muricata* appears to be extremely rare. Nelmes found herbarium specimens from only four British localities: from near Woodchester, W. Gloucs., v.c. 34, collected by G. C. Druce in 1900; from the top of a limestone hill near Wrexham, Denbigh, v.c. 50, gathered by J. E. Bowman in 1840; from limestone screes at Gordale, Mid-W. Yorks., v.c. 64, gathered by E. Milne-Redhead in 1934 and by J. E. Lousley in 1935; and from the grounds of the castle at Lauder, Berwick, v.c. 81, gathered by A. Brotherston in 1878.

David & Kelcey (1975) described the discovery, by Mrs B. M. Mack in 1973, of a Gloucestershire colony of this plant that may well be the same as Druce's; but searches elsewhere have been unsuccessful. The Gordale screes have, since the Second World War, been trampled bare by visitors' hobnails; there are so many limestone hills near Wrexham that to search for the plant there is like looking for a needle in a hundred haystacks; while at Lauder there seems to be no calcareous ground at all.

In November 1977, however, F. J. Roberts asked my opinion of a plant that he had found near Ribblehead, Mid-W. Yorks., v.c. 64, in 1974. He had had no reason to think that his find might be of importance, and the specimen was a poor one; but it seemed to me to show some of the characters of *C. muricata*, and it grew on limestone. In May and June 1978 I was able to examine the plant in the field, and there is no doubt whatever that it is the rarer taxon. Its distinctive characters are: the erect and rigid habit; the spikes, which are orbicular rather than ovoid as in *C. pairaei*, the lowest being often distinctly separated from the others; the glumes, which are dark and much shorter than the utricles from which, until the latter ripen and darken, they are marked off by a strong colour-contrast; and the outline of the utricle, which is more rounded than in *C. pairaei*, has a more distinct wing or flange, and is more suddenly contracted into the beak. A fifth character, the much earlier flowering time of *C. muricata*, was somewhat masked by the abnormal lateness of the spring in 1978.

The differences between the two taxa are precise and constant but they are not, in the opinion of A. O. Chater and of myself, sufficiently great to justify more than a subspecific distinction. The northern and eastern plant should then be known as *Carex muricata* L. subsp. *muricata*. I had hoped that Schultz's, and his friend Paira's, association with the western plant might be preserved in the name *C. muricata* L. subsp. *pairaei* (F. W. Schultz) Čelak. (Čelakovsky 1881), but J. Holub has drawn to my attention an earlier publication by Čelakovsky (1879) in which the plant is named *C. muricata* L. subsp. *lamprocarpa* Čelak., which is therefore its correct name.

At Ribblehead I found only four plants of the sedge, growing in slight shade on mossy limestone ledges at the edge of a limestone pavement. There is, however, some doubt as to whether my colony is the same as that originally seen by Mr Roberts, and there may well be more of the plant in the area.

REFERENCES

ČELAKOVSKY, L. J. (1879). *Analytická Květena Česká*, p. 88. Prague.

ČELAKOVSKY, L. J. (1881). Prodromus der Flora von Böhmen. *Arch. Naturw. Landes. Böhm.*, **4**, *Bot. Abt.*: 731.

DAVID, R. W. & KELCEY, J. G. (1975). *Carex muricata* L. *sensu* Nelmes and *Carex bullockiana* Nelmes. *Watsonia*, **10**: 412–414.

NELMES, E. (1947). Two critical groups of British sedges. *Rep. botl Soc. Exch. Club Br. Isl.*, **13**: 95–105.

R. W. DAVID

THE DISTRIBUTION OF *CAREX RUPESTRIS* ALL. IN BRITAIN

Carex rupestris All. is the most widely distributed of the four species of *Carex* Section *Petraeae* (O. F. Lang) Kük. Unlike its allies, which are steppe plants of dry sandy or rocky ground in North America (one of them, *C. obtusata* Liljebl., in north-eastern Europe as well), *C. rupestris* is arctic-alpine,

extending from the circumpolar region down the chain of the Rockies to Colorado; in Europe it reappears in the Pyrenees, Alps, northern Balkans and Carpathians. Further east it occurs in the Caucasus and the highlands of central Asia. It is strongly calcicole.

In Britain this sedge is confined to Scotland, and there to four areas: the Durness-Inchnadamph limestone, that of Kishorn, and the mica-schists of Breadalbane and of the Cairngorms-Clova region. In the first two it occupies large areas of exposed limestone; in the others it may be restricted to calcareous pockets in a chaos of rocks otherwise species-poor. Its presence in many of these places, and its abundance in some others, have until comparatively recently been over-looked. This is partly due to its small size (the tufts of leaves are likely to be less than 10 cm high and each leaf is less than 2 mm broad), and to its tendency to be shy-flowering. Even when it flowers the simple spikes, narrowly and smoothly cylindrical, may be missed; in the vegetative state it may easily be passed over as a small *Festuca*, and some erroneous records have been due to the same confusion in reverse. Yet to a botanist who is specifically looking for it the characteristically rigid carriage of the leaves, their greyish or brownish colouring, and their habit of corkscrewing at the tips will quickly signal its presence. Where it occurs it is likely to cover several yards, and in one Sutherland station it is more or less dominant for a third of a mile.

Carex rupestris favours ledges and outcrops of fissured limestone, into which its long rhizomes can penetrate, sending up multiple tufts through the cracks. It may also be found in damp rendzina. In both habitats it is very frequently associated with *Dryas octopetala*, although in some stations, for example the first two quoted below for Easterness, the two plants occupy quite separate areas. *Carex rupestris* is not a plant of very high altitudes: in Scotland its upper limit appears to be below 3000 feet, while it descends almost to sea level in West Sutherland.

Every British station that I have been able to trace is listed below, with grid-references. With the exception of four of the more remote (Meall na Samhna, Glen Einich, Loch Loch, Glas Tulaichean), all have been personally visited since 1970, and as age must now limit my explorations it seems best to publish the findings and so encourage others to extend them. The sizes of the populations that I have myself surveyed are indicated by the letters A = 1 to 20, B = 21 to 100, C = 101 to 1000, D = over 1000. Where I have failed to refind the sedge, the date of, and authority for, the last sighting are given. The authenticity of the herbarium specimens quoted has been confirmed by me.

Mid Perth, v.c. 88: 27/4.3, Ben Heasgarnich, 1886 (White 1898); Meall na Samhna, 1960 (M. E. D. Poore field record); 27/5.3, Meall Ghaordie, 1893, **BM**, **E**, **GL**; Coire Fionn Lairige, 1963 (J. G. Roger field record); Meall nan Tarmachan, 1963 (J. G. Roger field record); 27/5.4, Creag an Lochain, 2 places (A, B); 27/6.4, Coire nam Buidheag (C); 27/6.5, Carn Gorm and An Sgor (B).

E. Perth, v.c. 89: 27/9.6, Ben Vrackie (B); 27/9.7, Ben Vuirich (C); Loch Loch (Ratcliffe 1977); 37/0.7, Glas Tulaichean, 1971 (Roger 1972); 37/1.7, The Cairnwell (C).

Forfar, v.c. 90: 37/1.7, Caenlochan (B); 37/2.7, Glen Fiagh, 1976 (Mrs J. Pitt field record); Glen Doll (B).

S. Aberdeen, v.c. 92: 37/1.8, Coire Kander (C); 37/1.9, Creag an Dail Bheag (C).

Easterness, v.c. 96: 27/6.7, Allt Coire Chuirn (B); 27/8.9, Coire Garbhlach (B); 27/9.9, Glen Einich, 1967 (J. G. Roger field record).

Main Argyll, v.c. 98: 27/2.2, Coire Fionn Choirain, 1963 (S. Ward field record).

W. Ross, v.c. 105: 18/8.4, Sgurr a Gharaidh (D); above Loch an Loin (B); 18/8.5, Mheallaidh Wood, field record at Biological Records Centre unconfirmed and most unlikely (off the limestone); 18/9.2, Mam Ratagan (Druce 1929), doubted by Druce himself and unlikely; 29/1.0, Knockan (B).

W. Sutherland, v.c. 108: 29/1.1, Knockan (B); 29/2.1, Beinn an Fhuarain (D); Beinn nan Cnaimhseag (C); 29/2.2, Inchnadamph (D); 29/3.1, Breabag (B); 29/3.6, Loch Borralie (B); 29/4.5, Ard Neackie (A); 29/4.6, Smoo (C); Heilam (D).

Outer Hebrides, v.c. 110: 08/8.3, Beinn Mhor (S. Uist), 1930 (Harrison 1941), unconfirmed and probably an error.

REFERENCES

DRUCE, G. C. (1929). *The flora of West Ross*, p. 94. Arbroath.

HARRISON, J. W. H. (1941). A preliminary Flora of the Outer Hebrides. *Proc. Durham phil. Soc.*, **10**: 228–273.

RATCLIFFE, D. A. (1977). *A nature conservation review*, **2**: 273. Cambridge.

ROGER, J. G. (1972). Day excursion to Glas Tulaichean. *Trans. Proc. bot. Soc. Edinb.*, **41**: 565–566.
WHITE, F. B. W. (1898). *The flora of Perthshire*, p. 321. Edinburgh.

R. W. DAVID

OPHRYS APIFERA HUDS. IN ARTIFICIAL HABITATS

Hill (1978) has described the annual variation, from 1971 to 1977, in the number of plants and in the number of flowers per inflorescence in two closely situated colonies of *Ophrys apifera* Huds. on gravel and sand near the edge of a pool in disused gravel workings in W. Gloucs., v.c. 34. The habitat was unusual in that most of it was dominated by *Betula* and *Salix* scrub, and the water table was high.

Of the eleven stations for *O. apifera* known to me in Denbigh, v.c. 50, Flint, v.c. 51 and north-western Cheshire, v.c. 58, all but one have been derived from man's activities, and one is similar to Hill's site. Although more natural sites exist despite heavy grazing of the limestone areas of Clwyd, I have not recorded the orchid from them. It seems reasonable to suggest that the survival of *O. apifera*, and perhaps other plants in the British flora, now somewhat ironically depends to a significant extent on the conservation of man-made habitats.

At most of the sites the soil contained both clay and comminuted limestone and the most frequent associates were *Blackstonia perfoliata, Dactylorhiza fuchsii* and *Linum catharticum*. Where the peripheral terrain was suitable, the association included many components of the rich, regional limestone flora. Some of the most interesting, at different sites, were *Hypericum montanum, Linum bienne* and *Scabiosa columbaria*. The individual characteristics of some of the other sites are mentioned briefly in the following notes.

1. Minera, Denbigh (GR 33/2.5). Six orchids were found on a mound of fine limestone and marly clay detritus in the older part of a still active quarry on 2nd August, 1972, and possibly the same six plants on 6th July, 1974. This locality is remarkable for the variety and abundance of Orchidaceae. There were *Coeloglossum viride, Gymnadenia conopsea, Listera ovata* and *Orchis mascula* in the immediate vicinity with numerous *Dactylorhiza purpurella, Epipactis helleborine* and *Anacamptis pyramidalis* not far away.
2. Gresford, Denbigh (GR 33/3.5). A scattered colony of 20 plants was seen on 27th June, 1971, on a weathered, mixed dump of boulder-clay and sand in a corner of a sand and gravel quarry. The colony seemed to be much the same on subsequent visits, about every other year, up to 20th June, 1978. A larger compact colony, about 100 m from the first, on a flushed, clay-rich slope, was destroyed by quarrying in 1977, but in June, 1978 another hundred or so plants were seen close by in groups of 4 to 12 over a 100 m square of low ridges in a waterlogged area. They had presumably reached the flowering stage between 1971 and 1978. An adjacent wet clay level was dominated by *Festuca arundinacea* and encroaching *Salix viminalis*. This station evidently bears some resemblance to that described by Hill.
3. Bodfari, Flint (GR 33/0.7). 30 plants were seen on 1st July, 1972, on a 20 m length of thin, stony soil flushed by seepage from the high, fissured quarry face.
4. Prestatyn, Flint (GR 33/0.8). A single plant was noticed on inner coastal dunes on 15th July, 1972, but the locality was not searched further.
5. Whitford, Flint (GR 33/1.7). Three fine plants were found in bare, shallow soil on the edge of lightly flushed slabs below a quarried limestone face on 17th July, 1971.
6. Holywell, Flint (GR 33/1.7). About a dozen plants were seen on 31st July, 1977, on a grassed rubble slope, but no note was taken of associates in the species-rich vicinity.
7. Rhydymwyn, Flint (GR 33/2.6). A small colony, including four plants just coming into flower, was seen on 23rd June, 1971, on coarse limestone rubble on a high terrace above an operational quarry. The plants were small and the situation apparently dry, although the proximity of *Dactylorhiza* suggested occasional flushing.
8. Ffrith, Flint (GR 33/2.5). At this site the fissured, irregular limestone outcrop has been haphazardly worked, presumably for local building. About 25 plants were seen on 19th June, 1973, on a considerable barren bank of fragmented rock and slipped clay.
9. Llanfynydd, Flint (GR 33/2.5). Here a quarry, now disused, has been cut back into the hillside creating a roofless cavern of considerable size, with a moist floor relatively bare save for a few

abandoned blocks and low mounds of fine debris. A colony of *c* 65 plants was found on the mounds on 27th June, 1974, and another 30 or so were seen on debris tipped down the hillside. On 19th June, 1975, only five or six plants were found at each site, and in 1978 none could be seen. Sheep had invaded the peripheral zone and the quarry had been heavily used for clay-pigeon shooting.

10. Ledsham, Cheshire (GR 33/3.7). A compact colony of 17 plants was found on 27th July, 1968, on gritty, calcareous clay moistened by seepage from an adjacent bank and previously covered by a stone platform. On 20th June, 1968, six good plants (but only one opening flower) and seven basal rosettes were seen.

11. Stanlow, Cheshire (GR 33/4.7). A scattered colony of *c* 20 plants on the grassy banks of the containment bunds around a group of tanks in an oil storage depot was shown to me on 1st July, 1974. The tank foundations were laid on limestone aggregate and the earth bunds were composed of clay and limestone chips. The orchids had been seen by the depot-manager in earlier years. The plants were small but healthy, evidently benefitting from the scything carried out at the site, especially before and after the main growing season, in order to reduce fire risks.

REFERENCE

HILL, D. A. (1978). A seven year study of a colony of bee orchids (*Ophrys apifera* Hudson). *Watsonia*, **12**: 162–163.

T. EDMONDSON

PUCCINELLIA CAPILLARIS (LILJEBL.) JANS. × *P. MARITIMA* (HUDS.) PARL. ON NORTH RONA, OUTER HEBRIDES

In 1972 *Puccinellia capillaris* (Liljebl.) Jans. was found on North Rona, a small island to the north of the Outer Hebrides, v.c. 110 (Gilbert *et al.* 1973). The plants appeared very variable, and it was thought at the time that other species or hybrids might be present. On a further visit to North Rona in 1976 two species were recognized: *Puccinellia capillaris* on bare ground on the low-lying peninsulas, and *P. maritima* (Huds.) Parl. in crevices in and grassland above low cliffs. In several places on Fianuis, the northernmost peninsula, the two species were growing together. Neither plant had been recorded from the island up to 1958 (McVean 1961), and we conjecture that *P. maritima* was overlooked whereas *P. capillaris*, a species which appears to be spreading in northern Scotland, is probably a recent arrival.

The *P. capillaris* plants were morphologically distinctive, taking the form of green adpressed rosettes with relatively few tillers and numerous flowering culms. The lemmas were 2.3–2.7 mm long, often enclosing the developing grain, and the short anthers (0.8–0.9 mm) dehisced to liberate abundant spherical pollen. The species appears to be a short-lived perennial adapted to a habitat which is heavily disturbed by gulls and seals. By contrast, the plants of *P. maritima* were tufted, with green or greyish leaves and rather stiff tillers and flowering culms radiating from the central stock. The lemmas and anthers were 3.3–4.0 and 1.5–2.0 mm long respectively, and developing grain and good pollen were again regularly present. This biotype of *P. maritima*, which is characterized by a lack of stolons, is quite common on the mainland of Scotland.

A collection of both dried and living material from Fianuis was submitted to Dr C. E. Hubbard who reported that one of the live plants was more or less intermediate between *P. capillaris* and *P. maritima* and, judging from spikelet characters, was a hybrid between the two species. The plant was tufted in habit, with spreading, green leaves, loose, ovoid panicles, lower lemmas 3.3–3.5 mm long, and indehiscent anthers 1.0–1.8 mm long in which over 90% of the pollen grains were imperfect (irregular in shape and size, and colourless). The plant has been kept alive at Hampton but failed to flower in 1977. Its chromosome number has not been determined. The hybrid should have $2n = 42$; Dr K. Jones (*in litt.* 1977) found that Caithness material of *P. capillaris* had the chromosome number $2n = 28$, while $2n = 56$ is the main number reported for *P. maritima* (Scott & Gray 1976).

This hybrid, which was described as *P.* × *mixta* by Holmberg (1920), has been recorded from Denmark, Holland, Iceland, Norway and Sweden (Jones & Stace 1975), so that its occurrence in Britain is not unexpected. Herbarium specimens have been deposited in **K**.

REFERENCES

GILBERT, O. L., HOLLIGAN, P. M. & HOLLIGAN, M. S. (1973). The flora of North Rona 1972. *Trans. Proc. bot. Soc. Edinb.*, **42**: 43–68.

HOLMBERG, O. R. (1920). Einige *Puccinellia*-Arten und Hybriden. *Bot. Notiser*, **1920**: 103–111.

JONES, B. M. G. & STACE, C. A. (1975). *Puccinellia*, in STACE, C. A., ed. *Hybridization and the flora of the British Isles*, pp. 558–560. London.

MCVEAN, D. N. (1961). Flora and vegetation of the islands of St Kilda and North Rona in 1958. *J. Ecol.*, **49**: 39–54.

SCOTT, R. & GRAY, A. J. (1976). Chromosome number of *Puccinellia maritima* (Huds.) Parl. in the British Isles. *Watsonia*, **17**: 53–57.

O. L. GILBERT & P. M. HOLLIGAN

ULTRAVIOLET PHOTOGRAPHY OF THE COLOURS AND PATTERNS OF FLOWERS

The colours and patterns of insect-pollinated flowers include ultraviolet components that are visible to many insect pollinators but not to the human eye. Many if not most insect pollinators – bees, hoverflies, moths and butterflies – probably have trichromatic colour vision with ultraviolet as one of their three primary colours. Thus the (to us) hidden ultraviolet patterns of flowers, and ultraviolet colour differences between the flowers of different species or genotypes, are likely to be important adaptive characters.

Surveys of ultraviolet (UV) absorption and patterning in flowers have been published by Daumer (1958) and Kugler (1963), and several new investigations have been published recently, but there is still a serious lack of information about the UV characteristics of the flowers of the great majority of species, even those of many otherwise well-known members of the British flora. Flowers are still commonly described only in terms of the colours and patterns that are visible to the human eye.

The photographic techniques that were used by Daumer involved quartz optics and special films for UV photography, but Kugler used unmodified Leica optics and ordinary Perutz monochrome film, which were quite satisfactory for the long UV wavelengths that are visible to bees. Kugler used a Schott UG1 filter to exclude visible light and an electronic flash-gun to provide UV light. Similar techniques were described by Silberglied (1976) and Hill (1977), but all these techniques require the use of a fixed camera or at least a tripod, which is often impossible and usually inconvenient and undesirable in the field. The field technique described by Eisner *et al.* (1969), using a hand-held television camera, is potentially useful for rapid surveys of UV colouration in the field but requires bulky and expensive equipment and does not provide permanent records of satisfactory quality.

I have found that it is relatively easy to photograph the UV image of flowers by a modified version of Kugler's technique, using a hand-held 35 mm single-lens reflex camera. I have used this modified technique quite extensively in the field since 1976. No special lenses are required. Visible light is excluded by a hand-held filter (Schott UG1 or Kodak Wratten 18A) that effectively transmits light only between about 300 and 400 nm; an ordinary monochrome film (Ilford FP4 or Kodak Tri-X) that is not sensitive to the small amounts of far-red and infra-red light that are also transmitted by these filters is used. A small electronic flash provides sufficient UV light. The procedure is very simple: the flower is brought into focus in the viewfinder and then the camera is held in position while the filter, also hand-held, is placed over the lens. The UV exposure is then made, the filter is removed, and a paired full-spectrum (visible-light) exposure is made on the next frame. It is advisable to make a second UV exposure.

The chief difficulties of this hand-held technique are caused by the small depth of focus that is obtained in close-up photography at the wide apertures (f1.4–4) that are needed for the UV exposure, combined with the impossibility of using the viewfinder after the filter has been placed over the camera lens. A steady hand is necessary. When colour photographs are required in addition to the paired UV and full-spectrum monochrome exposures, they can be taken using the same lens transferred to a second camera body that is loaded with colour film.

There are, from the point of view of the UV-blind human observer, two particularly striking and unexpected features of the UV colours and patterns of flowers:

a) The common occurrence of UV patterning in yellow flowers (and capitula of composites) in which a

UV-absorbing centre is surrounded by UV-reflecting outer parts. To the human eye, such flowers appear uniformly yellow, or almost so; to a UV-sensitive insect, they have a conspicuous pattern with a central insect-red area in an otherwise insect-purple flower (e.g. *Potentilla anserina*). In other cases yellow flowers are wholly UV-absorbing (e.g. *Potentilla fruticosa*). Yellow flowers that look very similar to us are often sharply distinct in UV, either because they have different UV patterns or because they differ in UV reflectance (e.g. *Brassica* species).

b) The extreme rarity of UV-reflecting white flowers. Although a few white flowers with strong UV reflectance (insect-white flowers) do exist, Daumer (1958) did not report finding any flowers of this type in a survey of 204 species. I have investigated 126 British species with white flowers and found only four species with insect-white flowers (*Bryonia dioica* and white variants of *Raphanus raphanistrum, R. maritimus* and *Verbascum lychnitis*).

The great majority of flowers that appear white to the human eye are strongly UV-absorbing (insect-yellow). These flowers reflect light strongly and uniformly in our visible spectrum from about 700nm to 425nm; below *c* 425–405nm their reflectance falls sharply and only a few show significant reflectance below 390nm. In order to quantify the different shades of UV colour shown by flowers it is necessary to obtain reflectance spectra (Kay 1978). In every case that I have investigated in detail UV absorption in white flowers is caused by flavone or flavonol pigments. Patterning, with a more strongly UV-absorbing central region, is much less well developed in white flowers than in yellow flowers, and when it does occur relatively small differences in R^{50} (the wavelength at which 50% of peak reflectance is shown) are involved: *c*12nm in the case of *Calystegia silvatica*, for example, compared with differences of 120nm or more in similarly UV-patterned yellow flowers. The UV-absorbing white flowers of different species are probably differentiated from one another in many cases, to the insect eye, by comparably small differences in R^{50} over the range of wavelengths between *c* 380nm (e.g. *Hesperis matronalis*, R^{50} 382 nm) and *c* 430nm (*Arabis hirsuta*, R^{50} 418nm; *Trifolium repens*, R^{50} 426nm); I have found very few flowers with petal R^{50}s between *c* 430nm and the lower end of the yellow range at *c* 490nm. Photography using UV-transparent filters can only give a qualitative indication of the occurrence of this type of differentiation among white flowers, and quantitative photometric studies are necessary to characterize it precisely.

REFERENCES

DAUMER, K. (1958). Blumenfarben, wie sie die Bienen sehen. *Z. vergl. Physiol.*, **41**: 49–110.

EISNER, T., SILBERGLIED, R. E., ANESHANSLEY, D., CARREL, J. E. & HOWLAND, H. C. (1969). Ultraviolet video-viewing; the television camera as an insect eye. *Science, N.Y.*, **166**: 1172–1174.

HILL, R. J. (1977). Technical note: Ultraviolet reflectance-absorbance photography; an easy, inexpensive research tool. *Brittonia*, **29**: 382–390.

KAY, Q. O. N. (1978). The rôle of preferential and assortative pollination in the maintenance of flower colour polymorphisms, in RICHARDS, A. J., ed. *The pollination of flowers by insects*, pp. 175–190. London.

KUGLER, H. (1963). UV-Musterungen auf Blüten und ihr zustandekommen. *Planta*, **59**: 296–329.

SILBERGLIED, R. E. (1976). Visualization and recording of long-wave ultra-violet reflection from natural objects. *Functional Photography*, **11**: 20–29, 30–33.

Q. O. N. KAY

RUBUS DENTATIFOLIUS (BRIGGS) W. C. R. WATS. AND *R. VECTENSIS* W. C. R. WATS.

Watson (1937) gave a new name, *Rubus vectensis*, to a bramble which Rogers (1892, 1900) had illegitimately called *R. borreri* Bell-Salter. Watson's last (1958) opinion was that this is synonymous with *R. retrodentatus* Muell. & Lefèv., but reference to the holotype of the latter species (herb. Mueller, 2410, **LAU**) shows that this view cannot be sustained; *R. vectensis* is therefore currently used as the valid name for this bramble, which is widespread and frequent in many southern and western counties of England and Wales. Since it also occurs in southern Ireland and south-western France, it is a species of wide geographical range and major rank.

That *R. vectensis* exhibits rather a broad spectrum of variation (particularly in the intensity of stem armature) is evident from Sudre's remarks on specimens from Tarn, France (Bat. Eur. 429), which I

translate: 'I have come to the conclusion that my *R. pauciglandulosus* var. *montisparsus* of which I have seen only one example was nothing more than an open ground and well-developed form of *R. borreri*. This seems to be identical with the English Set 38.' These latter specimens were collected in Dorset and are *R. vectensis*. Sudre also issued Bat. Eur. 428 (also from Tarn) as *R. schmidelyanus* var. *breviglandulosus* and thought it (transl.) 'intermediate between type and *R. borreri*'. In my opinion this is an example of the less intensely prickled variant but should also be called *R. vectensis*.

Rogers (1894) stated 'further study of living bushes . . . has convinced me that we have a well-marked variety of the true *R. borreri* Bell-Salt. in the form described and named *dentatifolius* by the late Mr Briggs in Fl. Plym. 121 . . . I know it to be a locally abundant and constant form . . . from Plymouth and Launceston to Okehampton and Haldon Hill near Exeter . . . the typical plant being thus far unknown in the province'. [*R. borreri sensu* Rogers ≡ *R. vectensis* W. C. R. Wats.]

During 1977 I examined large numbers of bushes in the field in Brecon, W. Gloucs., Wight and S. Devon (the Exeter district, Haldon Hill and western Dartmoor from Plymouth to Okehampton) growing in various conditions (open to shady) and on various soils. The plants throughout these areas exhibited virtually a continuous range of variation from sparsely prickled almost eglandular stems to strongly prickled, aciculate examples; panicles tended to vary similarly in intensity of armature and glandulosity, and terminal leaflet shapes varied from narrowly obovate with cuspidate tips through broadly obovate with cuspidate-acuminate tips to elliptic-obovate with attenuate tips. Throughout these areas, however, the floral characters, e.g. petal size and shape, sepal clothing and disposition, panicle shape and leaf indentation, were constant. The less intensely armed variant tends to be more evident in damp, shady situations in S. Devon than elsewhere, but the complete range of variation is present there also. A batch of '*R. borreri*' from **BM** (herb. Barton & Riddelsdell nos. 736, 1294, 4580, 4636, 3834–6, 10468–71, 10490–2/3/6/7, 10595), gathered from a number of localities between W. Gloucs. and W. Kent, exhibits similar characteristics. All the evidence, therefore, points to the existence of one taxon only. The type of variation observed is to be found in other *Rubus* species, e.g. *R. infestus* Weihe ex Boenn., *R. anisacanthos* G. Braun and *R. leyanus* Rogers, for which H. E. Weber (pers. comm. 1978) has recently proposed the Section name *Anisacanthi*; I conclude that *R. vectensis* should be included in this group.

What then is the correct name for this bramble? Visits to Briggs' localities and reference to the large number of syntypes of his *R. sprengelii* Weihe var. *dentatifolius* (**CGE**, **K**) reveal the full range of variation; Briggs' (1880) original description includes 'extreme forms with panicles with longer and less uniform prickles intermixed with numerous aciculi' and his concept was clearly of one taxon with varying armature. It was Rogers' view that two taxa, '*R. borreri*' and '*R. borreri* var. *dentatifolius*', are to be sustained.

After careful consideration I conclude that, *pace* Rogers, we are here dealing with one somewhat variable species, which should be known as:

Rubus dentatifolius (Briggs) W. C. R. Wats., in *Lond. Nat.*, **1930**: 73 (1931)
R. sprengelii var. *dentatifolius* Briggs, in *Fl. Plymouth*, p. 121 (1880)
R. vectensis W. C. R. Wats., in *J. Bot., Lond.*, **75**: 197 (1937)
R. borreri auct.

LECTOTYPUS: Ringmoor Down near Sheepstor, S. Devon, v.c. 3, T. R. A. Briggs, 14th August, 1869, as *R. borreri* var. (**K**); isolectotype (**CGE**)

Set of British Rubi nos. 38 & 63, present in many herbaria, exemplify the limits of variation to be observed in this species.

REFERENCES

BRIGGS, T. R. A. (1880). *Flora of Plymouth*. London.
ROGERS, W. M. (1892). An essay at a key to the British *Rubi*. *J. Bot., Lond.*, **30**: 271.
ROGERS, W. M. (1894). *Rubi* notes. *J. Bot., Lond.*, **32**: 41–50.
ROGERS, W. M. (1900). *Handbook of British* Rubi. London.
WATSON, W. C. R. (1937). Notes on *Rubi*, 16. *J. Bot., Lond.*, **75**: 197–198.
WATSON, W. C. R. (1958). *Handbook of the* Rubi *of Great Britain and Ireland*. Cambridge.

A. NEWTON

RUBUS DREJERI G. JENSEN IN SCOTLAND

Rubus drejeri G. Jensen has hitherto been a doubtfully British bramble. Although Rogers (1900) described it accurately (apart from the omission of pilose anthers) and possessed specimens sent to him by Gelert and Focke, he applied the name somewhat broadly to several British species, e.g *R. anisacanthos* G. Braun. I have not, however, seen any of Rogers' sheets from the Stirling district (including Lochs Earn and Vennachar), v.c. 86, referred to in his article (Rogers 1897); these may well have been the true *R. drejeri*. The brambles of Surrey and S. Somerset referred to by Watson (1952) are both unnamed local taxa and his description and figure (Watson 1958) present a composite of these; they differ from *R. drejeri* in significant respects.

In 1978 I collected specimens exactly matching Danish and German examples of *R. drejeri* in **MANCH** and my own herbarium from two places near Blairgowrie, E. Perth, v.c. 89 (GR 37/1.4). One bush was growing by the riverside walk just north of the town bridge, and a clump of several bushes was found on the west side of the A 923 at the edge of an old birch wood about a mile south of the town. Further examples of the same bramble have been sent to me by G. H. Ballantyne from Fife, v.c. 85: east of Lochgelly (GR 36/1.9), and Cluny, east of Cardenden (GR 36/2.9). *R. drejeri* is evidently well established in eastern central Scotland and should be looked for elsewhere in the area, particularly in Rogers' localities.

This is an addition to the list of *Rubus* species growing on both sides of the North Sea given by Newton & Weber (1977).

REFERENCES

NEWTON, A. & WEBER, H. E. (1977). *Rubi* common to the British Isles and north-western continental Europe. *Watsonia*, **11**: 380–382.

ROGERS, W. M. (1897). On some Scottish *Rubi*. *J. Bot., Lond.*, **35**: 42–50.

ROGERS, W. M. (1900). *Handbook of British* Rubi. London.

WATSON, W. C. R. (1952). *Rubus* L., in A handlist of the plants of the London area. *Lond. Nat.*, **31** (Suppl.): 74–99.

WATSON, W. C. R. (1958). *Handbook of the* Rubi *of Great Britain and Ireland*. Cambridge.

A. NEWTON

THE ALTITUDINAL RANGE OF *CATABROSA AQUATICA* (L.) BEAUV.

Catabrosa aquatica (L.) Beauv. is generally regarded as a plant of lowland streamsides, ditches and ponds, and, chiefly in north-western Britain, of damp sandy sea-shores. In Westmorland, v.c. 69, where it is a rare and declining species, Wilson (1938) gave its habitat as 'Pool sides and watery places in the low country' and its altitudinal range as '20–400ft or higher'. In his *Comital Flora*, Druce (1932) gave the altitudinal limit as 1000ft.

It came, therefore, as a considerable surprise when one of us (F. J. R.) discovered it in July 1978 at 2300ft (710m) on the east side of Little Fell, Westmorland (GR 34/78.21; **LANC**). Two colonies were found, 40m apart, growing in gently sloping, east-facing flushes, lightly trampled by sheep and associated with:

Agrostis stolonifera	*Leontodon autumnalis*	*Saxifraga stellaris*
Cochlearia officinalis	*Montia fontana*	*Veronica beccabunga*
Chrysosplenium oppositifolium	*Ranunculus flammula*	*V. scutellata*
Epilobium alsinifolium		

According to the *Atlas of the British flora*, *C. aquatica* has been recorded from only four 10km squares in which there is no land below 500ft. Two are pre-1930 records: one from Talbotstown, Wicklow, v.c. H20, and the other from near Clatt, N. Aberdeen, v.c. 93. These two sites lie at about 800 and 680ft respectively. Of the two post-1930 sites, one is from boggy ground by the River Greta west of Bowes, N. W. Yorks., v.c. 65, and probably between 1000 and 1100ft. The other locality, near Malham Tarn, Mid-W. Yorks., v.c. 64, is well known. Here it grows in several sites on cattle-trampled, silty stream-banks up to 1225ft and associated with:

Carex flacca	*Eleocharis uniglumis*	*Poa trivialis*
C. lepidocarpa	*Juncus articulatus*	*Ranunculus flammula*
Eleocharis palustris	*Poa annua*	*Veronica beccabunga*

The Little Fell locality is therefore 1100ft higher than Malham and 1300ft higher than Druce's limit. Although *C. aquatica* occurs only in the lowlands in northern Norway (Benum 1958), it occurs in 'many places in the central highlands' in Iceland (Gröntved 1942) and Suessenguth (1936) gave its upper limit as 2200m (7200ft) in the Engadine.

REFERENCES

BENUM, P. (1958). The flora of Troms fylke. *Tromsø Museums Skrifter*, **6**.
DRUCE, G. C. (1932). *The comital Flora of the British Isles*. Arbroath.
GRÖNTVED, J. (1942). The pteridophyta and spermatophyta of Iceland. *The botany of Iceland*, **4(1)**.
SUESSENGUTH, K. (1936). *Catabrosa*, in HEGI, G. *Illustrierte Flora von Mitteleuropa*, 2nd ed., **1**: 383–384. Munich.
WILSON, A. (1938). *The flora of Westmorland*. Arbroath.

F. J. ROBERTS & G. HALLIDAY

LYCOPODIELLA INUNDATA (L.) HOLUB AT FOX TOR MIRES, SOUTH DEVON

Fox Tor Mires is a large topogenous valley bog at the head of the catchment of the River Swincombe, which flows into the West Dart River on Dartmoor, S. Devon, v.c. 3. I carried out a floristic survey of the Mire in 1971, as it was proposed as a reservoir site to supply water to Plymouth, and any inundation of the area would have markedly altered the vegetation. (The proposal was eventually rescinded in favour of another site). Part of the Mire, known as Whiteworks, where the Strane River flows into the River Swincombe, at GR 20/618.709, has been disturbed by past surface-mining for tin. The name 'White' works indicates kaolinization of the granite around the tin lodes (Worth 1953). The operations started about 1800, reached a peak in the 1880s and ceased in about 1905. They were temporarily revived during the First World War. The presence of water and china clay prevented tunnel mining, resulting in 'tinner's furrows' (Worth 1953), which were deep gullies (1–4m) following the tin lodes. These gullies are now filled with *Sphagnum* bog with associated *Juncus* species and *Polytrichum commune*. The excavated waste material was piled into mounds 1–3m high on the ridges between the gullies. The surface of these mounds (still a regolith rather than a soil) supports a xerophytic community of *Calluna vulgaris* (with *Hypogymnia physodes* as an epiphyte on the larger plants), *Vaccinium myrtillus, Cladonia* species (notably *C. impexa*) and *Dicranum bonjeanii*. There is thus a marked microtopographical and moisture gradient between the very dry mounds and the wet bog. The intermediate communities, which grade from the xerophytic heath to a *Juncus effusus/Polytrichum commune* community at the base of the mound, contain mainly *Agrostis setacea, Potentilla erecta, Galium saxatile, Polygala serpyllifolia, Pleurozium schreberi* and *Rhytidiadelphus loreus*. In this community on one mound I discovered a large plant of *Lycopodiella inundata* (L.) Holub. A careful search of the other mounds revealed three additional plants. In the autumn of 1974, after a prolonged wet summer, I discovered one further specimen, but it is possible that this was missed on the first occasion.

It is interesting to speculate on the source of these plants. The mounds are completely man-made and are at most 150 years old, and the final disturbance did not cease until between 1905 and 1918. I have searched the surrounding mire for specimens of *L. inundata* in more 'natural' habitats, but have not discovered any local source for colonization of these mounds. The nearest S. Devon records in the *Atlas of ferns of the British Isles* (Jermy *et al.* 1978) are from valley bogs on the pebble-bed heaths, near Aylesbeare, 50km to the east.

Unfortunately the plants suffered severely in the drought of 1976; all but one plant dried up and there has been no recovery to date.

REFERENCES

JERMY, A. C., ARNOLD, H. R., FARRELL, L. & PERRING, F. H. (1978). *Atlas of ferns of the British Isles*, p. 5. London.

WORTH, R. H. (1953). The physical geography of Dartmoor, in SPOONER, G. M. & RUSSELL, F. S., eds. *Worth's Dartmoor*, pp. 3–46. Newton Abbot.

D. L. WIGSTON

NOTHOFAGUS BLUME IN BRITAIN

There is growing interest in species of *Nothofagus* in this country as it is possible that there will be widescale plantings of some species in the near future by both public and private forestry organizations, and one species, *N. obliqua* (Mirbel) Blume, the Roble, has been suggested as a possible replacement for elm. I have received a number of enquiries about *Nothofagus* from B.S.B.I. members, particularly those who saw a young specimen of *N. procera* (Poeppig & Endl.) Örsted, the Rauli, in the Chelsea Physic Garden after the 1978 Annual General Meeting.

The following is a list of all *Nothofagus* species known by me to have been planted in Great Britain; they are placed under their area of origin.

AUSTRALIA
N. moorei (F. Mueller) Krasser

TASMANIA
N. cunninghamii (Hooker) Örsted

NEW ZEALAND
N. fusca (Hooker fil.) Örsted
N. menziesii (Hooker fil.) Örsted
N. solandri (Hooker fil.) Örsted
var. *cliffortioides* (Hooker fil.) Poole
N. truncata (Colenso) Cockayne

SOUTH AMERICA
* *N. alessandrii* Espinosa
* *N. antarctica* (G. Forster) Örsted
N. betuloides (Mirbel) Blume
N. dombeyi (Mirbel) Blume
* *N. glauca* (Philippi) Krasser
N. nitida (Philippi) Krasser
* *N. obliqua* (Mirbel) Blume
* *N. procera* (Poeppig & Endl.) Örsted
* *N. pumilio* (Poeppig & Endl.) Krasser

* deciduous species

There are one deciduous Tasmanian species, *N. gunnii* (Hooker fil.) Örsted, 19 evergreen New Guinea species and 5 New Caledonian species (Van Steenis 1953), which to my knowledge have not yet been introduced into Britain.

Hybrids between New Zealand species are well known (Cockayne 1926), but hybrids which apparently have not been recorded in the native range of the genus occur in Britain. For example, the allopatric species *N. menziesii* (New Zealand) and *N. obliqua* (Chile) have hybridized at Weston-under-Lizard, v.c. 39 and 40. *N. obliqua* and *N. procera* are partially sympatric in their native Chile, but no native hybrids have been reported. *N. obliqua* × *N. procera* is present in Westonbirt Arboretum, W. Gloucs., v.c. 34, and at Alice Holt Lodge, N. Hants., v.c. 12, where it set seed in 1978, although it is not yet known if this is viable.

The majority of the species listed above only occur in gardens and arboreta, but three, *N. dombeyi*, the Coigue, *N. obliqua* and *N. procera*, have been planted as pure stands in England, Scotland and Wales. The first widespread Forestry Commission plantings took place in 1936 and 1937, mainly of *N. procera*, although one very fine *N. obliqua* stand of this age occurs at Kingswood Warren, Mendip Forest, N. Somerset, v.c. 6. A further set of plantings was made in 1956. Supply of seed in the past has been variable and of suspect identification; at Ladyswood, Kernow Forest, W. Cornwall, v.c. 1, in adjacent 1956 plantings of *N. obliqua* and *N. procera* there is a specimen of *N. menziesii*. Also, all Forestry Commission specimens I have seen determined as *N. betuloides* are undoubtedly *N. dombeyi*. *N. nitida* is of doubtful status, probably only a variety of *N. dombeyi*. The specimens I have seen in this country labelled *N. truncata* have none of the characteristics of this species (Bean 1976) and are probably *N. fusca*.

Since 1956, many private forestry estates have included *Nothofagus* species, mainly *N. obliqua* and *N. procera*, in their planting regimes (Bradford 1971), but Lord Bradford's estates at Weston-under-Lizard and Tavistock, S. Devon, v.c. 3, have included mixed and pure stands of *N. dombeyi*, and the Forestry Commission lists stands of this species in Wales. Undoubtedly, their most attractive economic feature is a very fast rate of growth (e.g. 75 ft in 13 years) producing a good quality hardwood timber. I

suspect that foresters also feel that their use will satisfy a demand for hardwoods in forest landscapes, particularly in respect of the recent 'small-wood grant' legislation which requires a proportion of hardwoods among conifers if grants are to be awarded.

N. obliqua and *N. procera* can both be coppiced, although growth of the coppice-shoots is light-demanding (particularly for *N. procera*) and can be totally suppressed under dense canopy. It is possible that the use of these species in the landscape will lead to a partial revival of coppicing; the Forestry Commission have experimental *N. procera* coppice plots at Flaxley, Forest of Dean, W. Gloucs., v.c. 34. Because of its ability to be coppiced it has been suggested that *N. obliqua* could be used in hedgerow management as a fast-growing replacement for elms ravaged by Dutch elm disease. However, both *N. obliqua* and *N. procera* are shallow-rooting and susceptible to windthrow, and their use in open positions, particularly as fast-growing trees in gardens or close to buildings, should be viewed with caution.

Pure stands of the deciduous *N. obliqua* and *N. procera* support a good native woodland ground flora and understorey, although, being relatively smooth-barked, epiphyte cover can be poor. The evergreen *N. dombeyi* appears to suppress ground cover, producing a deep litter which remains undecomposed for a long time. By contrast, the litter of *N. obliqua* and *N. procera* breaks down more rapidly than that of native beech.

N. antarctica, N. obliqua and *N. procera* were seeding freely in the summer of 1978, and the latter two species are certainly regenerating from seed in many of their sites in Britain. Introduced trees which produce substantial, easily-dispersed, seed-crops, can cause problems for conservation management of woodlands. The sycamore, *Acer pseudoplatanus* L., is an example, and careful observation of *N. obliqua* and *N. procera* regeneration is needed to see if they may present similar problems.

Nothofagus is closely related to the genus *Fagus*. Of all the species, *N. obliqua* and *N. procera* have the closest (if superficial) resemblance to our native hardwoods. These two are, however, unlikely to be confused with *Fagus sylvatica* L., but *N. procera* foliage resembles that of *Carpinus betulus* L. and the canopy resembles that of the fastigiate hornbeam, *C. betulus* 'Fastigiata'. *N. obliqua* can resemble the English elm, *Ulmus procera* Salisb., in form, but the foliage is unlikely to be confused.

REFERENCES

BEAN, W. J. (1976). *Trees and shrubs hardy in the British Isles*, 8th ed., **3**: 7–20. London.

BRADFORD, THE EARL OF (1971). The use of *Nothofagus* for forestry in the U.K. *Int. Dendrology Soc. Yr Bk*, **1970**: 20–23. London.

COCKAYNE, L. (1926). *Monograph on the New Zealand beech forests*. New Zealand State Forest Service Bulletin, **4**. Wellington.

VAN STEENIS, C. G. G. J. (1953). Results of the Archbold expeditions to Papuan *Nothofagus*. *J. Arnold Arbor.*, **34**: 301–374.

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