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Taxonomy of *Elodea* Michx in the British Isles

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ABSTRACT

Three species of *Elodea* are now known to occur in the British Isles: *E. canadensis* Michx, *E. nuttallii* (Planch.) H. St John and *E. callitrichoides* (Rich.) Casp. The taxonomic histories of the genus and three species are reviewed. Keys and descriptions of the species are given, together with details of their habitats and distribution.

INTRODUCTION

Elodea Michx is a New World genus, of which several species are known to be adventive in the Old World. A recent investigation (Simpson 1983) has shown three species to be adventive in the British Isles, namely *E. canadensis* Michx, *E. nuttallii* (Planch.) H. St John and *E. callitrichoides* (Rich.) Casp. (following Cook & Urmi-König's (1984) recommendation that plants previously referred to as *E. ernstiae* H. St John should now be assigned to *E. callitrichoides*). Simpson (1984) outlined the introduction and spread of these species in the British Isles. This paper presents a brief taxonomic history of the genus together with the British and Irish species, and summarizes the taxonomic conclusions drawn from the work in the form of a key and brief systematic accounts. A further paper in preparation will give a more detailed account of intraspecific variation in *E. canadensis* and *E. nuttallii*.

The vegetative structure of *Elodea* is comparatively simple, consisting of a series of axillary, branched, terete stems with narrow, sessile and minutely serrate leaves. Three decussate pairs of leaves occur on the lowest part of the stem, above which all the leaves are in whorls. The decussate leaves are also distinctly smaller than the whorled ones. A midrib is present in all leaves but no other venation is apparent. Epidermal hairs are absent from both stems and leaves. A pair of minute, entire, nodal scales (or squamulae intravaginales) are attached between the stem and leaf base on the adaxial side of the leaf. Adventitious roots are produced at the nodes, coinciding with the growth of a new stem. One root is produced with each stem, and root hairs occur only when the root is in sediment. Despite its simplicity, the vegetative morphology of *Elodea* is, in common with other aquatic macrophytes, highly plastic, and this has caused much of the taxonomic confusion. Such variation appears to be brought about by a variety of environmental factors, particularly in relation to light and temperature (Simpson 1983). The main growing season is between mid-April and mid-September. At other times growth is very much reduced or ceases completely. The plant overwinters by means of short, unbranched stems, or by the production of turions (hibernacula). The latter arise in the upper leaf axils during early autumn and may remain in situ, or break free and fall to the substrate, where they germinate the following spring.

The vegetative anatomy of *Elodea* reflects the plant's morphological simplicity. The stem consists of a single epidermal layer, a cortex consisting of parenchymatous and aerenchymatous tissues, and a simple stele with a central protoxylem lacuna. The leaf consists of only two cell layers. Stomata are absent and there is only a thin cuticle. Moreover there are no distinct strengthening tissues in the stem, and only 2–3 rows of sclerenchymatous cells along the leaf margins.

All the British and Irish species are dioecious. The female flowers are sessile and solitary in the leaf axils, and they usually occur within the 3–5 cm of the stem apex. Each consists of a perianth surmounting an elongated thread-like tube connected to the ovary. The latter is unilocular, containing three to ten ovules with either basal or parietal placentation. The ovary and lower part of the tube are enclosed by a membranous spathe (Fig. 1). The precise nature of the flower structure is disputed and some workers consider it to have a hypanthium (St John 1965; Lawrence 1976), whilst others suggest that it has an ovarian beak (Wylie 1904; Scannell & Webb 1976; Webb 1977; Dandy 1980). Close examination of the flower reveals that the tube is continuous with the ovary, and that there is no separate style within the tube. This suggests that the flower is epigynous, and that the latter interpretation is more likely to be correct.

Initially all parts of the flower are enclosed by the spathe. However the tube elongates rapidly, carrying the perianth bud to the surface and, when above the water, the bud opens, revealing three sepals, petals, stigmas and staminodes. The perianth is minute, being c. 3–7 mm in diameter. The flowers are ephemeral and, once mature, they rarely survive for more than 48 hours. They seem to be produced only when the top of the plant is within c. 0·5 m of the water surface and in still water (Simpson 1983). Consequently the production of flowers is infrequent, and this has undoubtedly added to the difficulties of separating the species.

In *E. canadensis* and *E. callitrichoides*, the general structure of the male flowers is similar to the female, the main differences being that the ovary is absent, and that the staminodes and stigmas are replaced by nine stamens. In *E. nuttallii*, the tube is absent and the spathe is more or less spherical, whilst at anthesis the whole flower breaks free from the plant and floats to the surface. Pollination in all species is achieved by the pollen grains being scattered on the water surface and drifting to the stigmas of the female flowers (St John 1965). Male flowers have only been recorded once in the British Isles, from a population of *E. canadensis* in the Braid Hills near Edinburgh, Midlothian, v.c. 83 (Douglas 1880). These plants were first found in 1879, but were not seen after 1903. I made an intensive search for male plants between 1978–1983, but without success, and it is most likely that no male plants of the three species are present in the British Isles. It is, of course, possible that such plants have been overlooked, but if they are present, then they must be rare.

In the absence of male flowers, reproduction is vegetatively apomictic. This is achieved by stem breakage, the stems being extremely brittle. The detached stems quickly produce adventitious

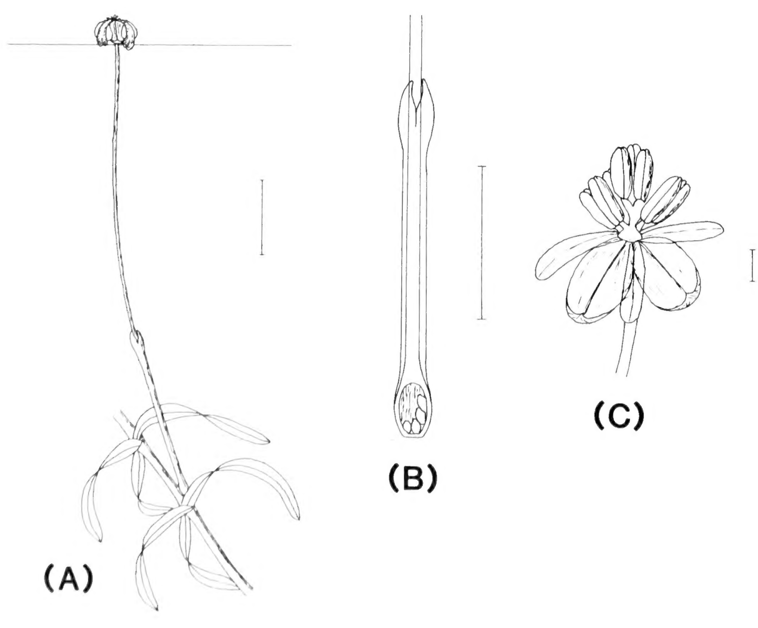

FIGURE 1. *Elodea*, structure of flowers. A, *E. nuttallii* whole female flower. B, *E. nuttallii*, lower portion of flower showing spathe and interior of ovary. C, *E. canadensis*, perianth of male flower from specimens gathered near Edinburgh, v.c. 83 (**K**). Scale bars = 1 cm.

roots, and soon become established as new plants. The effectiveness of this method as a means of rapidly increasing a population has been amply demonstrated by *E. canadensis* and, to a lesser extent, by *E. nuttallii*.

Determining the precise methods of spread is something of a problem which has never been completely resolved. In canals or rivers it has probably been aided by water movement carrying broken stem pieces. In both cases stem breakage is often increased by boat traffic, and pieces of plant can be carried within the wake caused by the boat. However, it is difficult to identify dispersal methods between isolated habitats, and in these cases agencies such as waterfowl could be involved. Although there is no direct evidence to support this, incidental observations during the present work suggest that plants can survive for several days in a humid atmosphere, and it is also possible that material could cling to, say, birds' feathers by the small teeth along the leaf margin. In some cases deliberate introduction by Man is likely to have occurred.

E. canadensis has the most widespread distribution of the three species. It is native to North America, being particularly common in the northern and eastern United States and southern Canada. It is also adventive in most of continental Europe and Australasia, as well as parts of Africa and Asia. *E. nuttallii* is also native to North America, although it is more or less confined to the northern and eastern United States. It is local but increasing rapidly in western continental Europe (Wolff 1980) and has also been introduced into Japan (Kunii 1982). *E. callitrichoides* is native to South America where it is common in southern Uruguay and northern Argentina. It has been introduced to continental Europe, and is presently known at a few localities in France and West Germany.

TAXONOMIC HISTORY OF THE BRITISH AND IRISH SPECIES

THE GENUS

Elodea was first described by Michaux (1803) in his *Flora Boreali-Americana*, but there were two earlier homonyms mentioned by de Jussieu (1789) and Ventenat (1799). These were orthographic variants of an earlier name, *Elodes* Adanson (1763), given to members of the Hypericaceae. Both de Jussieu and Ventenat attributed the homonyms to Adanson; however neither homonym was validly published, and *Elodea* Michx remains nomenclaturally correct.

Doubt was expressed by Babington & Planchon (1848) and later St John (1962) over the precise authorship of the name. Both produced a range of evidence to suggest that L. C. M. Richard was the original author. St John stated that, for many years, the staff at **P** believed that *Flora Boreali-Americana* was written by Richard and all names in this Flora should have been accredited to him. Further evidence of this was provided by Hooker (1842), who commented that Richard was the anonymous author of the Flora. Richard (1814) himself made some claim to authorship by stating that "je vais commençer par le description d'une plante qui appartent à un genre encore peu connu et auquel j'ai donné le nom d'*Elodea*". St John also noted the following statement, written by Richard, attached to the holotype of *E. guyannensis* Rich.: "J'ai retrouvé ce dessin et cette description dans une cartier d'observations fait à Cayenne. Je ne l'avais pas sans les yeux lorsque j'ai fait le caractère de la *Flora Boreali-Americana* de Michaux". St John concluded that this evidence was sufficient proof of Richard's authorship. He therefore used the citation "Richard in Michaux" throughout his papers. However there is, in fact, no conclusive evidence of Richard's authorship. The citation is not employed in *Index Kewensis* and, as far as is known, any other work applicable to the genus apart from St John. *Index Nominum Genericorum* does mention *Elodea* Rich., but as a later homonym of *Elodea* Michx, the former referring to Richard's (1814) description of the genus. As *Elodea* Rich. is a later homonym it is invalid. Consequently in the absence of published evidence to the contrary, the name should be credited to Michaux alone and not to Richard in Michaux.

Elodea was described by Michaux as monotypic, the species being *E. canadensis*, and he placed it in the Linnaean Class Triandra, believing the plants to have hermaphrodite flowers. This is interesting, because only pistillate flowers are to be found on the holotype. St John (1962) concluded that Michaux had either examined hermaphrodite flowers, which may occur very occasionally on this otherwise dioecious species or, more likely, he confused staminodes with anthers. Whatever the reason, Michaux's description of *Elodea* as hermaphrodite undoubtedly caused much of the confusion over the precise use of the name. Richard (1814) assigned a further two hermaphrodite species, both from South America, to *Elodea*, and he described a new genus, *Anacharis*, which contained dioecious material, also from South America. Rafinesque (1818), in a review of Pursh's *Plants of North America*, proposed the rejection of *Elodea* Michx on the grounds that *Elodes*, which was in contemporary use for segregates of *Hypericum*, was similar to *Elodea*. He suggested that the name *Philotria* Raf. should be adopted instead, but this did not gain widespread acceptance. Nuttall (1818) described a monotypic new genus, *Udora*, which was applied to dioecious material from North America. However, the description of this genus was essentially the same as that given by Richard (1814) for *Anacharis*, and it appears that Nuttall was unaware of Richard's work (St John 1962). Nevertheless, by 1848, three generic names were in use for material covered by the present-day concept of *Elodea*. *Elodea* sensu Michaux was hermaphrodite, *Udora* was both hermaphrodite and dioecious and *Anacharis* was dioecious.

Babington & Planchon's (1848) revision brought about a number of changes. The most significant of these was the reduction of *Elodea* to the synonymy of a new hermaphrodite genus *Apalanthe* Planch. By this time it was widely believed that Michaux had erroneously regarded his material as hermaphrodite, and because of this, Babington & Planchon considered *Elodea* to be incorrect for such material. *Udora* was also reduced to the synonymy of *Apalanthe* and *Anacharis*, the latter name being maintained for dioecious material. However Caspary (1857, 1858) restored *Elodea* and his interpretation of the genus included both hermaphrodite and dioecious plants. This concept rapidly gained acceptance in both America and Europe but, in the British Isles, the debate continued, fuelled by attempts to put a correct name to the British and Irish taxon. By the late 1870s, the majority of British and Irish botanical opinion agreed that the floral differences were not important enough to warrant the separation of two or more genera. This is confirmed by *Index Kewensis* which shows that, by 1885, *Elodea* had become generally accepted for both hermaphrodite and dioecious material.

Apart from a few minor nomenclatural changes, little further attention was paid to the genus until Victorin's (1931) revision, in which *Elodea* was again separated on flower structure. In this case he used *Anacharis* for dioecious material and *Philotria* for hermaphrodites. The basis for the change was his examination of a small amount of isotype material in **P** which did not have mature flowers. From this, Victorin concluded that Michaux's original description was erroneous, and consequently he rejected *Elodea*. Victorin believed it important to recognize the two genera as distinct for two reasons. Firstly, the number and arrangement of the stamens and staminodes differed between them. Secondly, work by Santos (1923, 1924) had shown that in dioecious material corresponding chromosomes differed in size between the sexes, whereas Victorin assumed that they were equal in the hermaphrodite plants.

St John's monograph (1962, 1963, 1964, 1965) again grouped both hermaphrodite and dioecious material into the one genus. However, two subgenera were recognized, *Elodea* for the 14 dioecious species and *Apalanthe* for the three hermaphrodite ones. Subgenus *Elodea* was divided into two sections, *Elodea* and *Natator* H. St John, by the behaviour of the male flowers at maturity. In section *Elodea* they remain attached to the plant, whilst in section *Natator* they break free and float to the surface. St John added a total of ten new species to the seven previously recognized and accepted by him.

THE SPECIES

E. canadensis was first described by Michaux (1803) as a hermaphrodite plant, and this was later taken up by Richard (1814). However Babington & Planchon (1848), having determined its dioecious nature, transferred it to *Anacharis*. It is of interest that their morphological description of the species differed from that of Michaux. In particular, the leaves are described as being linear-lanceolate and acute, whereas Michaux described them as oblong and obtuse. Their observations were made, in fact, on two specimens of staminate plants (*Drummond*, **K**; *Cleghorn*, **K**) which had abnormally longer, narrower leaves. Babington & Planchon also produced the first published description of the British and Irish plant, which they named *Anacharis alsinastrum* Bab. They were, however, unsure of the precise relationship between this plant and American material. Therefore they suggested the epithet *alsinastrum* to "prevent it being confounded with the American species and thus extending their range far beyond what may prove to be their natural limits". Their use of the epithet was derived from the plant's apparent similarity to *Elatine alsinastrum* L.

Caspary's (1857, 1858) interpretation of the species included both hermaphrodite and dioecious plants. The hermaphrodite part was based upon Michaux's description of the type specimens and on his personal examination of material from Bethlehem, Pennsylvania (*Schweinitz*, **K**); these plants are referred to *E. schweinitzii* (Planch.) Casp., a true hermaphrodite species, by St John (1962). The dioecious part was based on Babington & Planchon's descriptions of species assigned to *Anacharis*. Two further species were described: *E. planchonii* Casp. and *E. latifolia* Casp., both of which were later recognized by St John (1965) to be *E. canadensis*. *E. planchonii* was based on the Drummond and Cleghorn specimens mentioned above, and Caspary considered these to be sufficiently distinct to be treated as a separate species. The same applied to *E. latifolia* which had markedly broad, ovate leaves. Indeed, both represented a wide spectrum of variation which misled Caspary. Nevertheless, they were treated as separate species for many years until Victorin (1931) reduced *E. planchonii* to a variety of *Anacharis canadensis* and St John (1965) recognized both to be phenotypic variants of the latter. Moreover *E. canadensis* was considered to be both hermaphrodite and dioecious until St John (1962, 1965) recognized it to be nearly always dioecious. He also recognized *E. planchonii* to be based on staminate plants of this species.

The first specimens of *E. nuttallii* to be described were assigned to *Serpicula verticillata* L.f. (= *Hydrilla verticillata* (L.f.) Royle) by Muhlenberg (1813) as var. *β angustifolia*. However Nuttall (1818) made this variety synonymous with his *Udora canadensis* Nutt. The latter species was described as having oblong-ovate to linear-lanceolate leaves and with staminate flowers sessile and breaking free at anthesis. Nuttall based his description partly on Michaux's type material and partly on specimens collected by himself in Philadelphia (**BM**). The latter now represent the holotype specimens of *E. nuttallii*. The behaviour of the staminate flowers, which is characteristic of *E. nuttallii*, is also seen in *H. verticillata*, which may account for Muhlenberg describing his plant as a variety of *S. verticillata*. Babington & Planchon (1848) made *U. canadensis* synonymous with *Anacharis nuttallii*, and they suggested that British and Irish *A. alsinastrum* was closely related to this species, if not the same plant. Caspary (1857, 1858) went further and reduced *A. nuttallii* to the synonymy of *E. canadensis*.

Some years later, Small (1903) applied the name *Philotria minor* (Engelm.) Small to plants with linear, acute leaves and flowers less than 3 mm in diameter, occurring in the central part of the United States, whilst Rydberg (1906) described *P. angustifolia* Britton ex Rydb., which was similar to *P. minor*, but with larger leaves and slightly larger flowers, and which occurred in the central-eastern part of the United States. A third new combination was described in Britton & Brown (1913), namely *P. nuttallii* Rydb. ex Britton & Brown. The name was used for plants which were previously assigned to *P. canadensis*, but with more narrowly oblong and somewhat acute leaves. The characteristic feature of all three species was the staminate flowers, which were sessile and broke free at anthesis. St John (1920) amalgamated *P. angustifolia* and *Elodea minor* (Small) Farw. (= *P. minor*) into one species, *E. occidentalis* (Pursh) St John. *E. occidentalis* was described as having linear, flaccid leaves and a globose-apiculate staminate spathe which was c. 2 mm long. St John also recognized *E. nuttallii*, which differed from *E. occidentalis* in having oblong-lanceolate, firm leaves and an ovate-lanceolate staminate spathe 5–6 mm long. However he expressed doubt about the status of *E. nuttallii*, having seen specimens which showed the morphology of *nuttallii* but the floral structure of *occidentalis*. St John (1962, 1965) combined the two as *E. nuttallii*. The epithet, although later than *occidentalis*, had to be retained because Pursh's original use of the name was illegitimate and this invalidated its use by St John. It is of interest that the characters used to delimit *E. nuttallii* in St John (1920) are not used in his later interpretation.

E. callitrichoides has had a simple taxonomic history. It was first described by Richard (1814) as the type species of the genus *Anacharis*. It was transferred to *Elodea* by Caspary (1857, 1858) and remained in this genus as *E. callitrichoides* apart from a brief return to *Anacharis* suggested by Victorin (1931). St John (1963) separated *E. ernstiae* from *E. callitrichoides*, and all European material assigned to the latter was subsequently referred to this new species. However Cook & Urmi-König (1984) suggested that the characters used for separating the two species have no diagnostic value. Therefore *E. ernstiae* should be referred back to *E. callitrichoides*, a view which is accepted by the present author.

MATERIALS AND METHODS

Extensive use was made of both living and herbarium material in the study. Herbarium specimens were obtained from **ABD**, **BM**, **CGE**, **K**, **LANC**, **OXF**, **P** and **RNG**. A number of private herbaria were also examined, including the Freshwater Biological Association (**FBA**) and **herb R. Stokoe**. Although the work was concerned primarily with British and Irish material, specimens from Europe and America were also looked at for comparison.

Particular emphasis was placed on the use, wherever possible, of recently gathered living material. Such material was collected throughout the British Isles, but with a concentration in north-western England, where a wide range of variation was noted. A full list of sites is given in Simpson (1983), and voucher material for these collections is in **LANC**. Chromosome numbers given in the species descriptions were obtained from counts which I made on British and Irish material from 20 localities. These are also given in Simpson (1983). The counts were made from root-tips, which were pre-treated in paradichlorbenzene for two hours and fixed in 1:3 acetic alcohol overnight at 0°C., followed by hydrolysis in 1N HCl at 60°C for eight minutes. They were then stained in basic fuchsin for two hours and squashes prepared in either aceto-orcein or 45% acetic acid. Ten root-tips per plant and five plants per species were examined at each locality. Voucher material is in **LANC**.

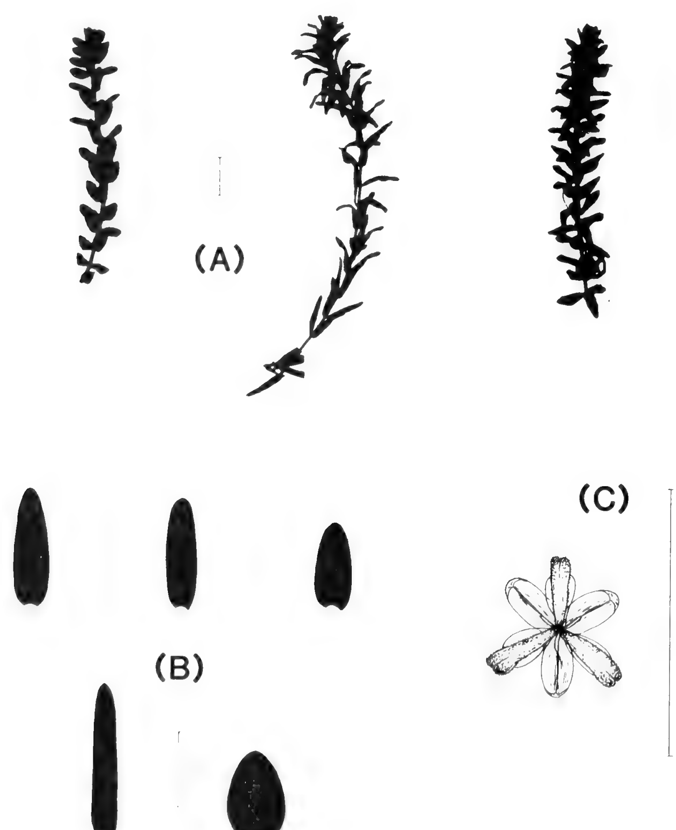

FIGURE 2. *E. canadensis*. A, silhouettes of plants. B, silhouettes of leaves. C, perianth of female flower. Scale bars = 1 cm.

KEY TO SPECIES

1. Leaves linear-oblong, oblong-lanceolate, oblong, oblong-ovate or ovate, rarely linear-lanceolate. Leaf apices broadly acute or obtuse, rarely narrowly acute, (0·7–)0·8–2.3 mm wide c. 0·5 mm below the apex .... 1. *E. canadensis*
1. Leaves linear or linear-lanceolate. Leaf apices narrowly acute or acuminate, 0·2–0·7(–0·8) mm wide c. 0·5 mm below the apex 2
2. At least some leaves strongly recurved. Leaf lamina often strongly twisted. Leaf margin teeth 60–90(–100) μm long. Adventitious root-tips (in living material) white or grey green. Sepals of female flowers 1·6–2·5 mm long .... 2. *E. nuttallii*
2. Leaves never strongly recurved. Leaf lamina rarely strongly twisted. Leaf margin teeth (80–)110–140 μm long. Adventitious root-tips (in living material) red. Sepals of female flowers 3·1–4·3 mm long .... 3. *E. callitrichoides*

SPECIES DESCRIPTIONS

1. *ELODEA CANADENSIS* Michx, *Fl. Bor.-Amer.*, **1**: 20 (1803). *Udora canadensis* (Michx) Nutt., pro parte, *Gen. N. Amer. Pl.*, **2**: 242 (1818). *Serpicula canadensis* (Michx) Eaton, *Man. bot.*, 5th ed., 390 (1829). *Anacharis canadensis* (Michx) Planch. in *Ann. Mag. Nat. Hist.*, ser. 2, **1**: 85 (1848). *Philotria canadensis* (Michx) Britton in *Science*, **11** (2): 5 (1895). TYPE: Environs de Montreal, *Michaux* (holotype: **P**). Fig. 2.

Anacharis alsinastrum Bab. in *Ann. Mag. Nat. Hist.*, ser. 2, **1**: 83 (1848).

Elodea latifolia Casp. in *Mber. kgl. Pruss. Akad. Wiss.*, 46 (1857).

Elodea planchonii Casp. in *Mber. kgl. Pruss. Akad. Wiss.*, 47 (1857). *Philotria planchonii* (Casp.) Rydb. in *Bull. Torrey bot. Club*, **35**: 462 (1908). *Elodea canadensis* var. *planchonii* (Casp.) Farw. in *Amer. Midl. Nat.*, **10**: 203 (1927). *Anacharis canadensis* var. *planchonii* (Casp.) Victorin in *Contr. Lab. Bot. Univ. Montréal*, **18**: 40 (1931).

Elodea oblongifolia Casp. in *Jb. wiss. Bot.*, **1**: 467 (1858).

Philotria iowensis Wylie in *Proc. Iowa Acad. Sci.*, **17**: 82 (1910). *Elodea iowensis* (Wylie) Wylie in *Nat. Hist. Bull. Iowa State Univ.*, **6**: 48 (1913).

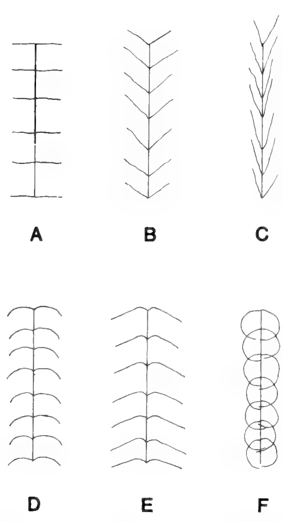

FIGURE 3. Leaf posture types. A, spreading. B, patent. C, erecto-patent. D, arcuate-deflexed. E, slightly deflexed c. 2–4 mm from the leaf base. F, strongly recurved, with leaf bases often touching or overlapping the stem.

Dioecious. Lowermost leaves on stem decussate, ovate, 1·8–9·0 × 0·7–2·0 mm; median and upper leaves in whorls of 3, linear-oblong, oblong, oblong-lanceolate, oblong-ovate, ovate, rarely linear-lanceolate, sometimes weakly twisted, 4·5–17·0 × 1·4–5·6 mm; leaf apices obtuse or broadly acute, rarely narrowly acute, (0·7–)0·8–2·3 mm wide c. 0·5 mm below the apex; leaf posture (Fig. 3) spreading, patent, erecto-patent or arcuate-deflexed, usually firm; leaf-margin teeth 40–70(–80) μm long. Female flowers with sepals oblong-elliptic, cucullate at apex, 1·9–2·8 × 0·6–1·7 mm, recurved, greenish-white, streaked with purple around apex and midrib; petals elliptic-spathulate, 1·8–2·5 × 0·8–1·5 mm, strongly recurved, translucent, whitish; staminodes linear, c. 1 mm long, white; stigmas strongly recurved or slightly bifid, flattened, 2·3–3·2 mm long, sparsely papillose, the papillae (110–)120–215 μm long, often purple. Male flowers similar to female but with staminodes, stigmas and ovary absent; stamens 9, anthers bilocular. Flowering period June-September. Adventitious root-tips white or grey-green. $2n$ = c. 24.

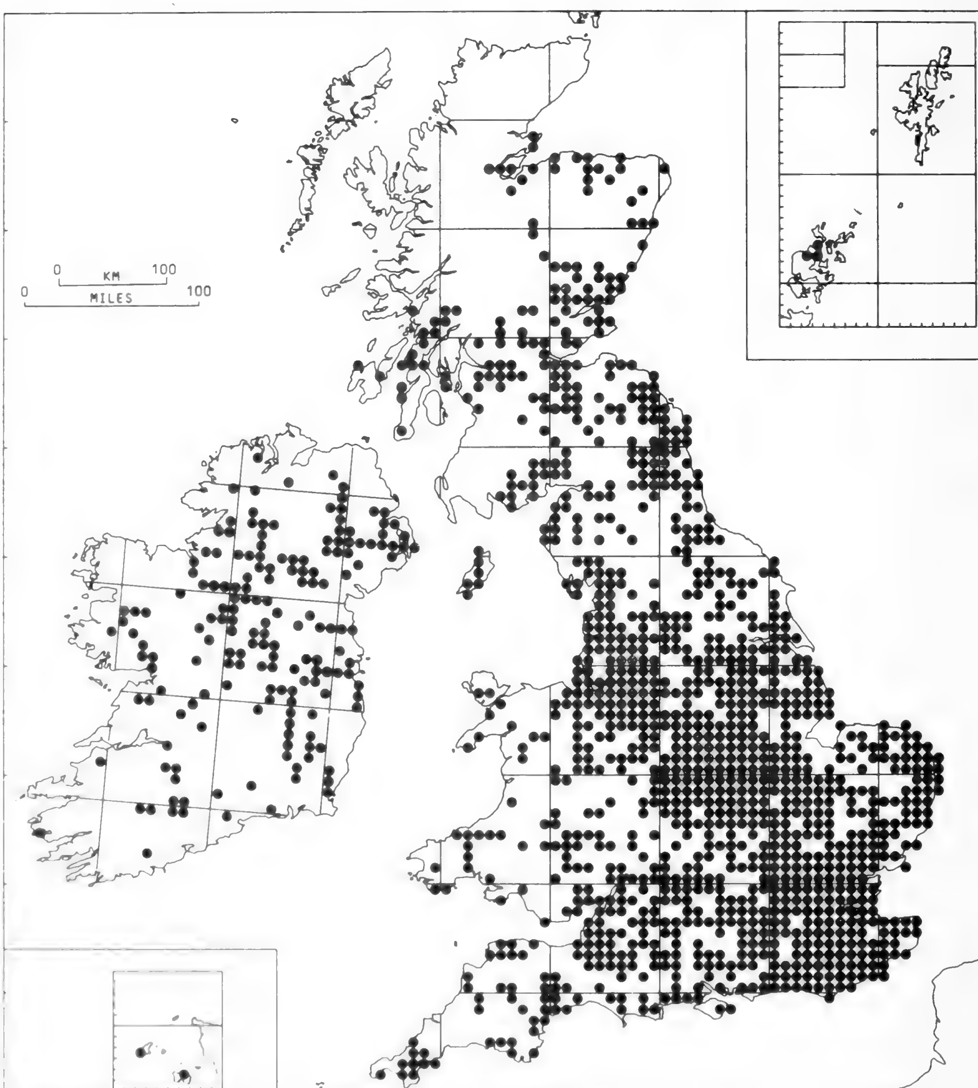

FIGURE 4. Distribution of *E. canadensis* in the British Isles.

Habitat and distribution (Fig. 4). *E. canadensis* occurs on fine substrates at c. 0·15–4 m depth, in unshaded, eutrophic to meso-oligotrophic water-bodies, where turbulence through water-flow or wave action is minimal. It is, therefore, most frequently found in lowland ponds, lakes, canals, slow-moving rivers and streams. It is also an early colonizer of new habitats, such as artificial lakes and water-bodies recovering from pollution. *E. canadensis* is widely distributed throughout most of the British Isles, being absent mainly from upland areas in the west and north, where habitats are generally unsuitable.

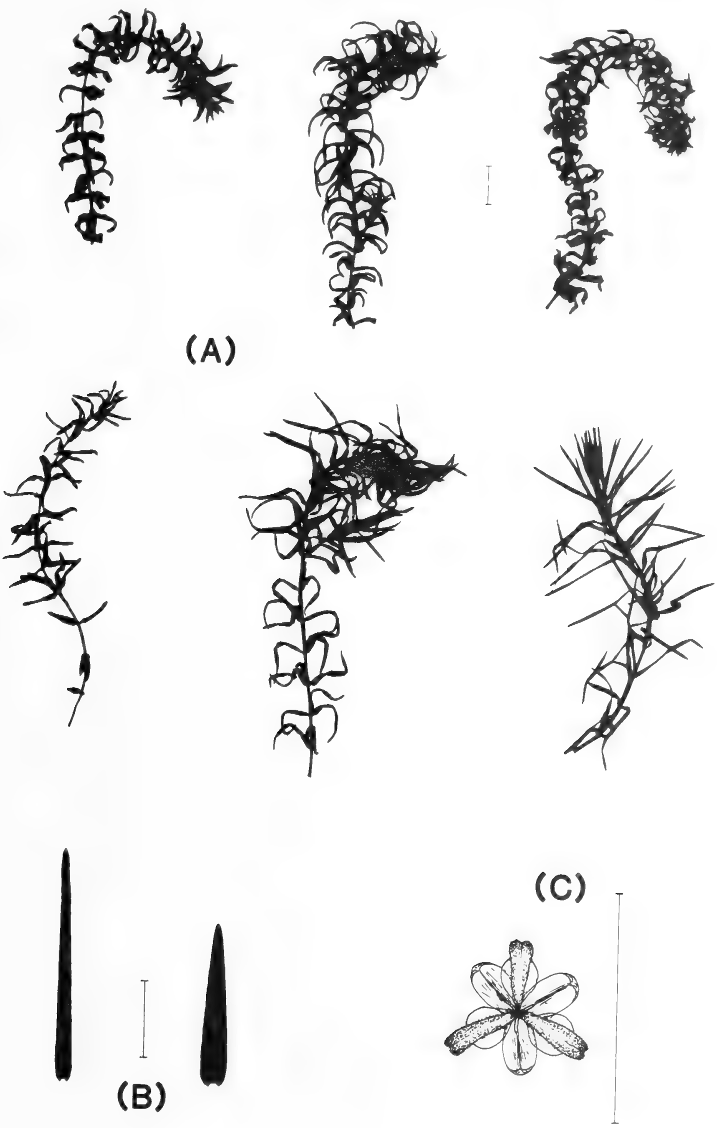

FIGURE 5. *E. nuttallii*. A, silhouettes of plants. B, silhouettes of leaves. C, perianth of female flower. Scale bars = 1 cm.

2. *ELODEA NUTTALLII* (Planch.) H. St John in *Rhodora*, **22**: 27–28 (1920). *Anacharis nuttallii* Planch. in *Ann. Mag. Nat. Hist.*, ser. 2, **1**: 86 (1848). *Philotria nuttallii* (Planch.) Rydb. ex Britton & Brown, *Illustr. Fl. n.-e. U.S.*, 2nd ed., 105 (1913). TYPE: Philadelphia, *Nuttall* (holotype: **BM**). Fig. 5.

Serpicula verticillata L.f. var. *β angustifolia* Muhl., *Cat. Pl. Amer. Sept.*, 84 (1813). *Elodea canadensis* var. *β angustifolia* (Muhl.) Farw. in *Amer. Midl. Nat.*, **10**: 203 (1927).

Serpicula occidentalis Pursh, *Fl. Amer. Sept.*, 33 (1814), nom. illegit. *Elodea occidentalis* (Pursh) H. St John in *Rhodora*, **22**: 27–29 (1920), nom. illegit.

Udora canadensis (Michx) Nutt., pro parte, *Gen. N. Amer. Pl.*, **2**: 242 (1818).

Philotria minor Small, *Fl. s.-e. U.S.*, 47 (1903). *Elodea minor* (Small) Farw. in *Rep. Mich. Acad. Sci.*, **17**: 181 (1916).

Philotria angustifolia Britton ex Rydb., *Fl. Colorado*, 15 (1906).

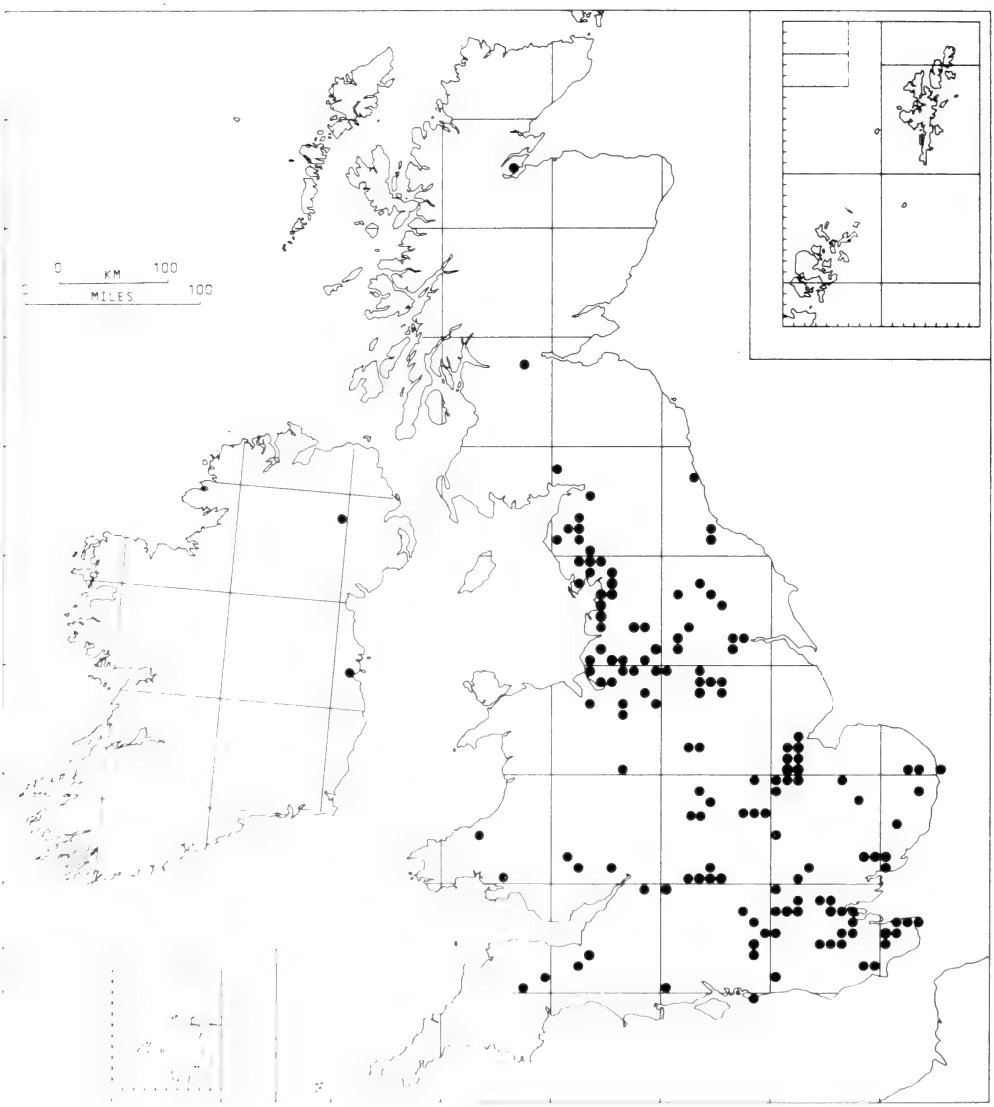

FIGURE 6. Distribution of *E. nuttallii* in the British Isles.

Dioecious. Lowermost leaves on stem decussate, ovate to linear-lanceolate, 2–8 × 0·5–5·0 mm; median and upper leaves in whorls of 3–4(–5), linear or linear lanceolate, often strongly twisted, 5·5–35·0 × 0·8–3·0 mm; leaf apices acuminate or narrowly acute, 0·2–0·7(–0·8) mm wide c. 0·5 mm below the apex; leaf posture (Fig. 3) strongly recurved, spreading, patent, erecto-patent, arcuate-deflexed, or slightly deflexed c. 2–4 mm from the leaf base, firm or flaccid; leaf-margin teeth 60–90(–100) μm. Female flowers with sepals oblong-elliptic, ovate, cucullate at apex, 1·6–2·5 × 0·9–1·8 mm, recurved, greenish-white streaked with purple around apex and midrib; petals suborbicular-spathulate, 1·9–2·6 × 0·9–1·8 mm, strongly recurved, translucent, whitish; staminodes linear, c. 1 mm long, white; stigmas strongly recurved, entire or slightly bifid, flattened, 2·2–3·2 mm long, sparsely papillose, the papillae 60–100(–110) μm long, sometimes purple. Male flowers with perianth sessile within the globose spathe, the whole flower breaking free at anthesis and floating; staminodes, stigmas and ovary absent; stamens 9, anthers bilocular. Flowering period June–September. Adventitious root-tips white or grey-green. 2n = c.48.

Habitat and distribution (Fig. 6). *E. nuttallii* occurs in similar habitats to *E. canadensis*. Although widely distributed in England, it is still less common than *E. canadensis*, but is continuing to increase. In Wales it is known in v.cc. 35, 41, 42, 46 and 51, whilst in Scotland it has been recorded from widely separated localities in v.cc. 72, 83 and 106. In Ireland it has been found in L. Neagh at Drumenny, Co. Tyrone, v.c. H36, and has also been introduced into a pond at the National Botanic Gardens, Glasnevin, Co. Dublin, v.c. H21.

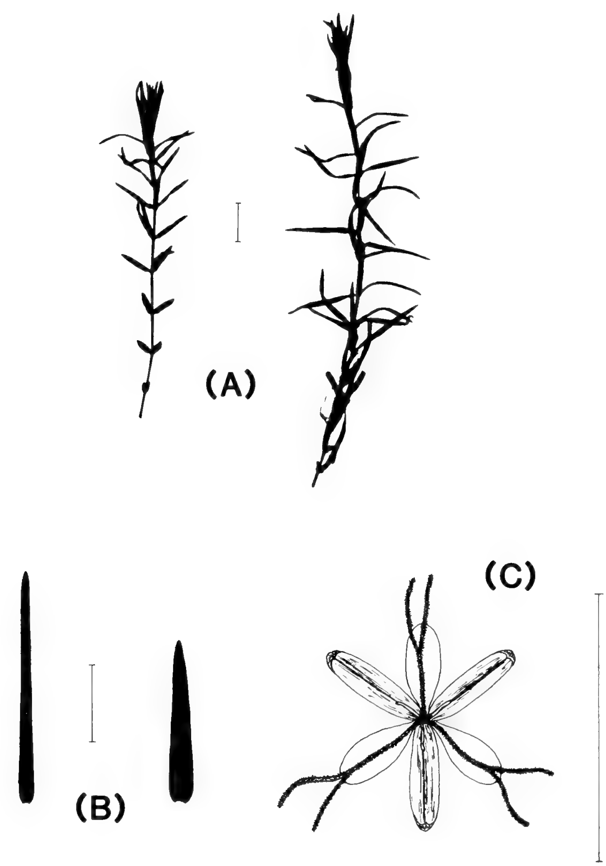

FIGURE 7. *E. callitrichoides*. A, silhouettes of plants. B, silhouettes of leaves. C, perianth of female flower. Scale bars = 1 cm.

3. *ELODEA CALLITRICHOIDES* (Rich.) Casp. in *Mber. kgl. Pruss. Akad. Wiss.*, 47–48 (1857). *Anacharis callitrichoides* Rich. in *Mem. Inst. France*, **12** (2): 7–8 (1814). TYPE: Montivideo, *Commerson* (holotype: **P-JU**). Fig. 7.
Elodea ernstiae H. St John in *Darwiniana*, **12**: 644 (1963).

Dioecious. Lowermost leaves decussate, ovate to linear-lanceolate, 3·0–14·0 × 0·5–1·2 mm; median and upper leaves in whorls of 3, linear or rarely linear-lanceolate, rarely strongly twisted, 9–25 × 0·7–2·2 mm; leaf apices acuminate rarely narrowly acute, 0·2–0·6 mm wide c. 0·5 mm below apex; leaf posture (Fig. 3) spreading, patent, erecto-patent, arcuate-deflexed or slightly deflexed c. 2–4 mm from the leaf base, usually flaccid; leaf-margin teeth (80–)110–140 μm long. Female flowers with sepals linear-oblong, linear-elliptic, cucullate at the apex, 3·1–4·3 × 0·9–1·6

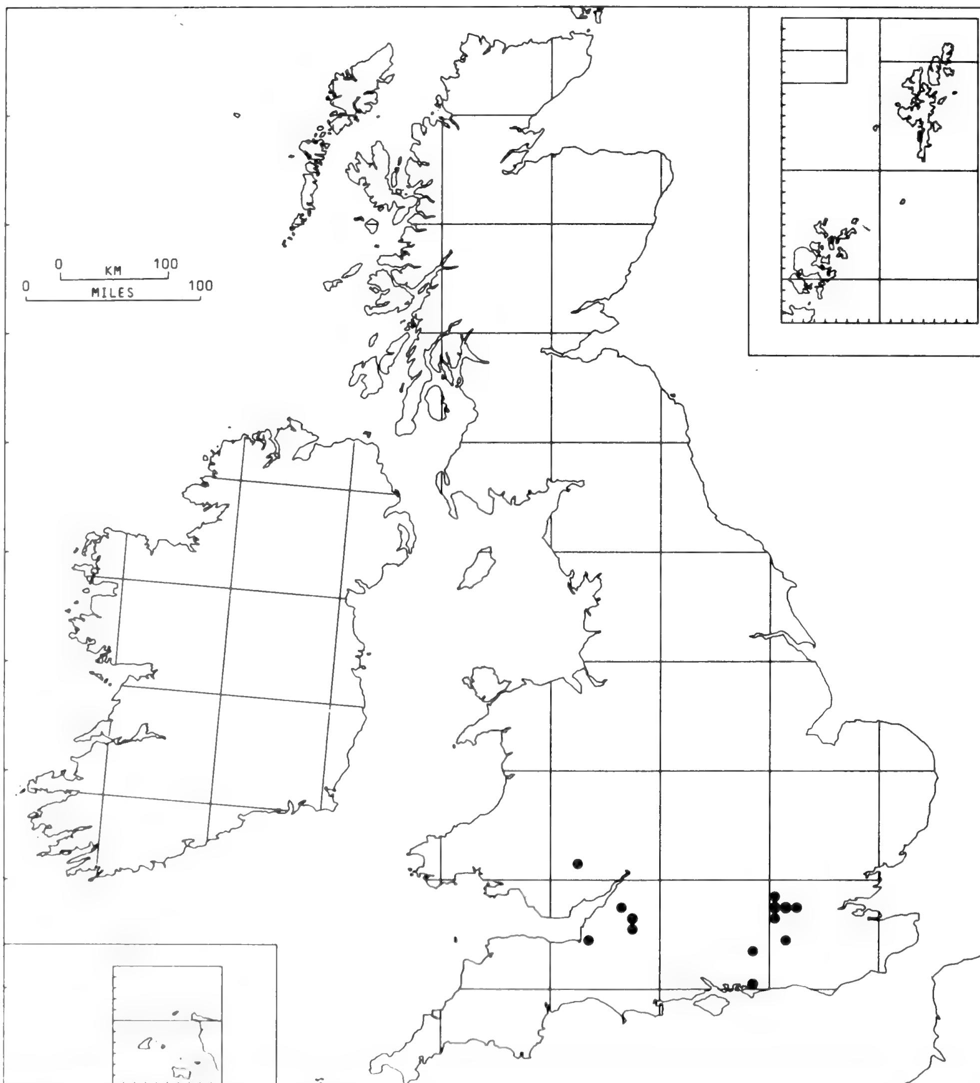

FIGURE 8. Distribution of *E. callitrichoides* in the British Isles. Map includes the 10 km squares from which the plant now appears to be extinct.

mm, spreading or slightly recurved, grey-green or greenish-white, heavily streaked with purple around the apex and midrib; petals oblong-elliptic, 2.9–3·8 × 1·0–1·8 mm, spreading or slightly recurved, translucent, whitish; staminodes linear, 1·5–3·8 mm long, white; stigmas spreading, deeply bifid, terete, 4.2–6·6 mm long, densely papillose, the papillae 120–215 μm long, purple. Male flowers similar to female but with staminodes, stigmas and ovary absent; stamens 9, anthers bilocular. Flowering period October–April. Adventitious root-tips red. 2n=c.32.

Habitat and distribution (Fig. 8). *E. callitrichoides* has been found in canals, ponds and slow-moving rivers. It is, however, a casual species and is currently known to occur in only two localities in v.cc. 13 and 42. It has not been recorded from either Scotland or Ireland.

ACKNOWLEDGMENTS

I wish to thank Dr G. Halliday for guidance during the course of the work and Prof. D. A. Webb for advice on nomenclature. Thanks are also due to the many correspondents who sent records, and to the Biological Records Centre for preparing the distribution maps.

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Variation in the colour of the keel petals in *Lotus corniculatus* L., 2. Clines in Yorkshire and adjacent counties

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ABSTRACT

The distribution of the dark-keeled morph of *Lotus corniculatus* L. (Leguminosae) has been surveyed at 182 sites in Yorkshire and neighbouring counties. The dark morph is rare in the west but increases eastwards, attaining high frequencies on the eastern coast. The slope of the cline is probably irregular, having steeper phases approximately 30 km from each coast. The cline is weak south of the study area, but it is pronounced north of the River Humber. The selective agent responsible for variation in morph frequencies has yet to be identified.

INTRODUCTION

The cyanogenesis polymorphism of *Lotus corniculatus* L. (Birdsfoot Trefoil) is well known and a number of selective forces partly responsible for maintaining the polymorphism have now been identified (Jones 1977; Compton *et al.* 1983a). Less well documented, although the variation is visually obvious, is the polymorphism for keel petal colour. Plants may bear either flowers with completely yellow keel petals ('light') or flowers which have red-brown tips to the keels ('dark'). The intensity of dark pigmentation varies greatly between the dark-keeled plants, ranging from a rich chocolate-brown encompassing the tip to a pale, diffuse, red pigmentation mainly confined to the front surface of the keel tip. The latter pattern has sometimes been described as 'pale' but as the distinction between pale and dark keels is somewhat subjective the two groups are together classed as darks in the present paper.

Keel colour is determined by a pair of alleles showing tetrasomic inheritance, dark keel being dominant to light (Hart & Wilsie 1959; Buzzell & Wilsie 1963; Ramnani & Jones 1984). Breeding work on North American cultivars (Bubar & Miri 1965) has suggested an epistatic interaction between loci involved in the expression of keel colour and cyanogenesis so that an excess of light-keeled acyanogenic plants is expected. However, in spite of extensive surveys of natural populations in Britain and continental Europe (Jones & Crawford 1977; Compton *et al.* 1983a; Compton *et al.* 1983b), no association between cyanogenesis and keel colour has been found; nor has breeding work on British material provided evidence for any epistatic interaction (Ramnani & Jones 1984).

Rather surprisingly, it seems that the dark keel tip was first recorded in 1955 and was regarded as an unusual variant in natural populations and as occurring at moderate frequencies in a minority of cultivars (Hart & Wilsie 1959). Attention was drawn to the widespread nature of the polymorphism, at least in western Europe, by Jones & Crawford (1977). Apart from the western, coastal, dune region of the Netherlands, where some populations monomorphic for light keels were found, polymorphism with varying frequencies of dark-keeled plants was almost universal. In

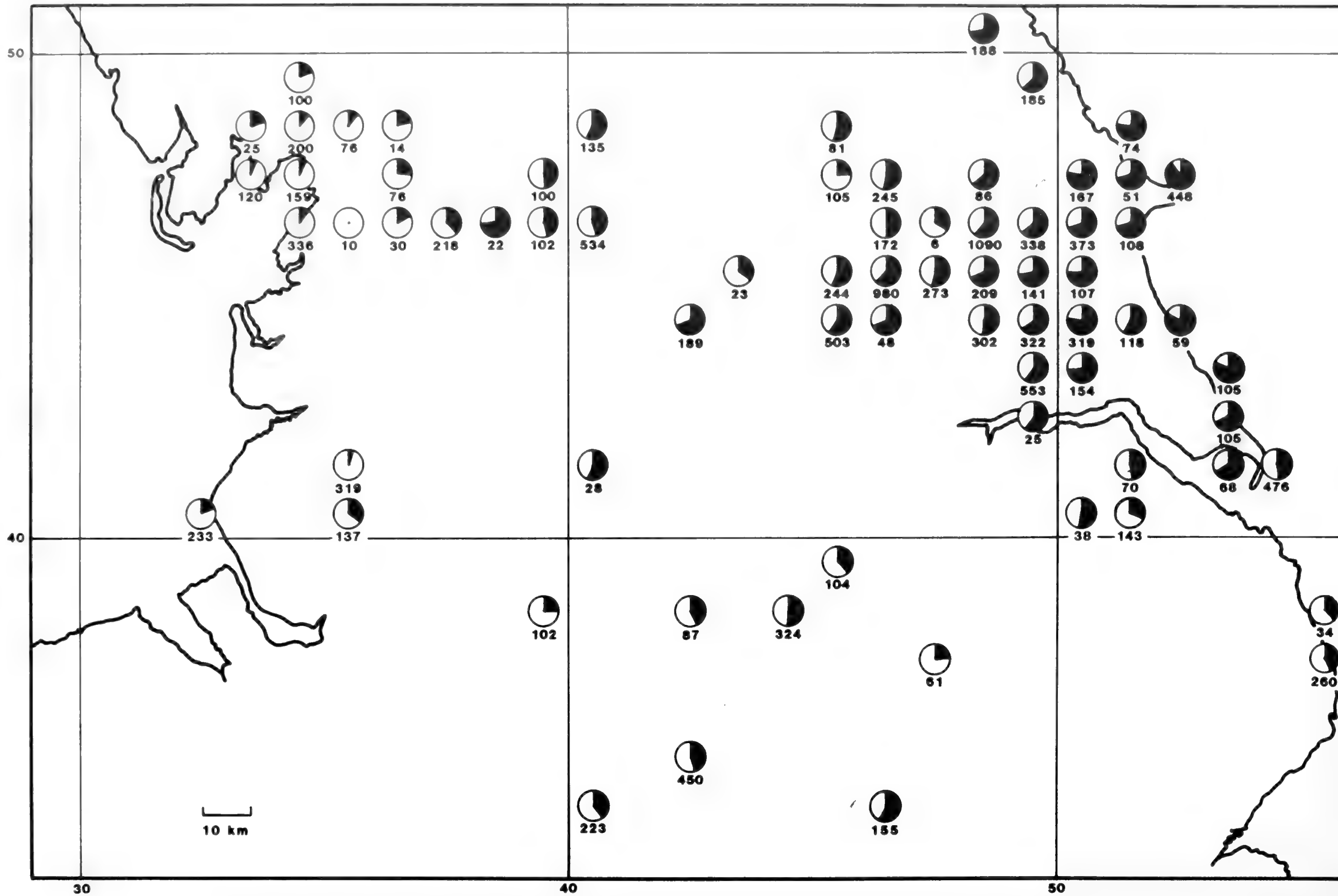

FIGURE 1. The distribution of the dark-keeled morph of *Lotus corniculatus*. Samples have been combined within National Grid 10-km squares. Black sectors are proportional to the dark-keeled frequency; the number of plants sampled is shown under each symbol.

England and Wales there was evidence for a clinal increase in frequency of the dark-keeled morph with latitude although there was no evidence for a similar cline in continental Europe. In Scotland, Abbott (1981) found that western populations generally have lower frequencies of dark-keeled plants than do those of central and eastern regions. Taking his data together with those from England and Wales, he suggested that the dark-keeled morph was relatively rare throughout western regions of the British Isles, but to the east the frequency increased with latitude so that it became the commoner morph in the north-east.

In this paper we describe the status of the polymorphism in Yorkshire and adjacent counties. Although the detailed picture remains unclear it seems that rapid clinal change occurs in this region in both west-east and north-south directions.

METHODS

Plants were scored for keel colour at 182 locations within the area shown in Fig. 1. Because *L. corniculatus* can spread by vegetative reproduction, only plants separated by at least 1 m were scored. Although keel colour could be used to discriminate between closely adjacent plants, such a procedure would introduce a bias against extreme frequencies. At least 100 plants were scored at 41%, and at least 50 plants at 69% of the sites.

Samples were combined within National Grid 10-km squares by the following procedure. Where the same site had been sampled more than once, the numbers of light and dark-keeled plants were summed over all replicate samples. The totals were then adjusted downwards to yield a single composite sample, equal in size to the largest individual sample but with the proportions of the two morphs reflecting those in the unadjusted totals. Data from different sites within a 10-km square were combined by simple summation, using adjusted totals for sites sampled more than once.

RESULTS AND DISCUSSION

Fig. 1 shows the proportion of dark-keeled plants in each 10-km square for which any information is available. The total number of plants scored, counting only the largest of replicate samples, is shown under each pie symbol.

The difference in the frequency of dark-keeled plants between western and eastern areas is striking, particularly in the more northern regions. For individual sites, both Red Bank (GR 34/471.678) in the west, with 0 out of 50 plants dark, and Flamborough (GR 54/240.722) in the east, with 99 out of 103 plants dark-keeled, represent extremes greater than any previously recorded in the British Isles. The results so far available suggest that the slope of the west-east cline is irregular. Dark-keeled plants remain rare for about 30 km from the western coast. There then seems to be a relatively sudden increase in darks, followed by a more gradual increase eastwards, until about 30 km from the eastern coast the dark keel frequency again increases rapidly. Whether these changes relate to proximity to the coast or more simply to longitude remains to be seen. Certainly it should be possible to distinguish between the alternatives by intensive sampling in western promontories such as North Wales, the Lake District and Galloway.

Sampling has been less intense in the southern part of the survey area, but it can be seen from Fig. 1 that the west to east increase in dark-keeled plants becomes more marked near to, but not necessarily coincident with, the River Humber. All available samples, including those from Jones & Crawford (1977), south of the National Grid 400 km Northing have been combined for each 100-km square, treating replicate samples as above. Table 1 shows that the eastwards increase in dark-keeled plants is reduced south of the River Humber. The data in Table 1, together with those presented in Fig. 1, confirm the suggestion (Jones & Crawford 1977; Abbott 1981) that the frequency of the dark morph, rare in the west, increases with latitude on the eastern side of the British Isles. It is clear, however, that the increase is not continuous, but occurs rather suddenly at a considerable distance south of the Scottish border.

Combining samples within 10-km squares clarifies the general picture at the expense of local detail. Although there is some local heterogeneity between sites within 10-km squares, the variation is certainly small compared with the scale of the clinal changes.

TABLE 1. PERCENTAGE FREQUENCY OF DARK-KEELED *LOTUS CORNICULATUS* AND, IN BRACKETS, TOTAL SAMPLE SIZE FOR NATIONAL GRID 100-KM SQUARES

	Easting					
Northing	1	2	3	4	5	6
3		12(538)	26(159)	47(2028)	35(392)	
2	2(100)	22(32)	35(3333)	43(633)	35(120)	
1				30(672)	25(64)	30(221)
0	22(50)		4(29)	16(186)		

The nature of the selective forces that might maintain the polymorphism remains a mystery. Jones & Crawford (1977) found no differences between the morphs for winter survival or for seed production in experimental plots. In natural populations, Jones *et al.* (in prep.) could find no associations between flower, pod or seed production with keel colour morph, nor with flower damage or seed predation by phytophagous insects. They also showed that pollinating insects failed to discriminate between the morphs in experimental populations. They suggest, however, that the frequency of dark-keeled plants may increase slightly as the flowering season progresses. In this context it is worth noting that the sites at the western end of the cline were in general sampled later than those to the east. There is some evidence (Buzzell & Wilsie 1963; Jones & Crawford 1977) that darks occur at a greater frequency in progeny raised under glass than in the parental populations from which the seeds were collected. This possibility deserves further attention. An explanation related to temperature has some a priori appeal because greater solar radiation absorbed by dark-keeled flowers may influence pollen, ovule or seed development. On the other hand, there is considerable altitudinal variation along the cline reported in this paper and it is clear that altitude itself has little effect on the morph frequencies.

Although dark-keeled plants are common at some inland locations in Europe (Jones & Crawford 1977), the regularly high frequencies of dark-keeled plants in north-eastern Britain are exceptional. It seems that the light morph more usually predominates and it may be inferred that selection commonly operates in favour of light keels. Nevertheless, populations monomorphic for light keel colour are rare and monomorphism for dark keels has yet to be recorded. It may be that some form of frequency-dependent selection is operating. Alien introductions, particularly on recently seeded roadside verges, are sometimes encountered. These plants differ from native plants in a number of respects (Jones 1977, 1982; Bonnemaison & Jones 1986), most strikingly in their long internode lengths. Their keel colour frequencies are sometimes distinct from the surrounding native populations and they have been excluded from this survey. Monitoring of alien populations may reveal changes in their keel colour frequencies over time and provide important information on the magnitude of the selective forces involved.

We would be grateful to receive information on this polymorphism from any localities. Care should be taken to exclude *Lotus uliginosus*, which is monomorphic for yellow keels. We require grid reference (as accurately as possible), date, brief description of habitat (e.g. chalk grassland, roadside verge) including any indications that the plants may be alien, and numbers (not proportions) of light and dark-keeled morphs. Plants should be sampled at intervals not less than 1 m and, although sample sizes of at least 100 are ideal, smaller samples are still useful.

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We thank Hazel Beacon and Harry Vallack for drawing Fig. 1. We are also grateful to the N.E.R.C. for supporting part of this work.

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Variation in *Senecio jacobaea* L. (Asteraceae) in the British Isles

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ABSTRACT

The variation in *Senecio jacobaea* L. in the British Isles is described. Two subspecies, subsp. *jacobaea* and subsp. **dunensis** (Dumort.) Kadereit & P. D. Sell, **stat. nov**., the former with two varieties, var. *jacobaea* and var. *condensatus* Druce, are recognized. The nomenclature and descriptions are formally set out and a list of herbarium specimens and published records are given for subsp. *dunensis* and var. *condensatus*.

VARIATION

The most significant variation within *Senecio jacobaea* L. in Britain and Ireland seems to occur in coastal populations. The normal plant of inland grassy places is tall, with widely-spaced leaves and a large open inflorescence of capitula which usually have ray florets and an outer row of glabrous achenes. In some coastal localities are to be found populations of shorter plants with dense arachnoid hairs on the involucres and peduncles, the ray florets absent or rudimentary and the outer row of achenes hairy. In the British Isles such populations have been recorded from the Scottish and Irish coasts and in continental Europe they occur on the Baltic or North Sea coasts of southern Norway, southern Sweden, E. Germany, Poland, Denmark, the Friesian Islands, Heligoland, the Netherlands and Belgium. Meijden (1976) has suggested that this taxon may be worth the rank of subspecies and we support this.

In other British coastal localities, particularly on dunes and shingle, occur populations of plants which have a greater tendency to produce a swollen area just below the basal leaves (described by Harper & Wood (1957) as a crown); they are shorter with up to three stems and have a dense inflorescence with short-liguled florets. This variant, which we have not seen from outside the British Isles, we consider best placed as a variety of subsp. *jacobaea*.

Further variation which occurs in subsp. *jacobaea* is not at the moment considered worthy of recognition. Occasional plants of inland populations are without ray florets. Plants with narrow ligules have been called var. *stenoglossus* Brenan & Simpson (Brenan & Simpson 1949), but do not seem to fit in an ecological niche, although they may be more frequent in the west of the British Isles than the east. Plants from chalk grassland tend to be more slender with very finely cut leaves, a persistent basal rosette and small capitula. A plant collected by G. Crompton on a sandy path through machair, Daleburgh, S. Uist on 12th August 1964 (**CGE**) differs from any other specimen we have seen in having a clothing of short glandular hairs.

NOMENCLATURE

Senecio jacobaea L. was first described by Linnaeus on page 870 of *Species Plantarum* in 1753. The diagnosis is taken partly from the *Hortus Cliffortianus* and is partly new. It is reasonable to assume the specimen in the Linnaean herbarium, *Savage Catalogue* 996/44, was used when making the amendments to *Hortus Cliffortianus* and it is designated as the lectotype.

Var. *nudus* Weston (1777) has been used by some authors for the coastal subspecies but there is no evidence as to whether Weston referred to coastal or inland plants. Var. *flosculosus* Lam. & DC. (1805) was said in the original publication to grow on dunes and other sandy places and is presumably our coastal subspecies, although neither we nor Meijden (1976) have seen specimens of it from France. *S. flosculosus* Jordan (1848), described without reference to the earlier published variety, was based on plants from shady pastures near Lyon and is not referable to the coastal populations. Var. *discoideus* Wimmer & Grab. (1829) was described from an inland site near Leobschütz (Głubczyce), Poland. *S. dunensis* Dumort. (1827) was described from coastal dunes in Belgium and is thought to be the most appropriate name to take up for the maritime subspecies.

The types of both var. *condensatus* Druce (1916) and var. *abrotanoides* J. Murr. ex Druce (1926) are referable to the variant with condensed habit and short ligules, the former having priority.

CHROMOSOME NUMBER

Böcher & Larsen (1955) referred to the ligule size of plants collected from Ireland of which they counted the chromosomes. Plants with long, narrow ligules from dunes near Lady's Island Lake, Co. Wexford, with 2n = 40 were probably referable to var. *jacobaea* of subsp. *jacobaea*. The plants from a roadside near Skull Harbour, Co. Cork, with 2n = 40 and possibly those from dunes near Kincasslagh, Co. Donegal, with 2n = 32 could belong to var. *condensatus*. Both have smaller than usual ray florets. Both 2n = 40 and 2n = 80 have been recorded for *S. jacobaea* by other authors.

SENECIO JACOBAEA L., *Sp. Pl.*, 870 (1753). Described as "Habitat in Europae pascuis" (Lectotype: *Savage Cat.* 996/44, **LINN**).

S. jacobaea var. *nudus* Weston, *Bot. Univ.*, 2nd ed., **3**: 641 (1777). Described without habitat or locality.

(a) subsp. *JACOBAEA*

Stems 1–3, up to 150 cm; peduncles with more or less numerous arachnoid hairs; ray florets usually present; outer row of achenes glabrous.

(i) var. *JACOBAEA*

S. jacobaea var. *discoideus* Wimmer & Grab., *Fl. Siles.* **2** (2): 153 (1829). Described from near Leobschütz (Głubczyce), Poland.

S. flosculosus Jordan, *Cat. Jard. Dijon*, 30 (1848). Described from near Lyon, France.

S. jacobaea var. *stenoglossus* Brenan & Simpson in *Proc. R. Ir. Acad.*, B, **52**: 69 (1949). TYPE: Hedgebank in a lane north of Banbridge, Co. Down, 5 August 1939, *J. P. M. Brenan 5730* (Holotype: **K**).

Stems not markedly swollen below the basal leaves, usually solitary, up to 150 cm; leaves rather widely spaced; inflorescence often large and open; ligules 7–9 × 1·7–3·0 mm, rarely absent.

(ii) var. *CONDENSATUS* Druce in *Rep. botl Soc. Exch. Club Br. Isl.*, **4**: 201 (1916). TYPE: Dunes and sea cliffs, Arbroath, Forfar, July 1915, *G. C. Druce* (Holotype: **OXF**).

S. jacobaea var. *abrotanoides* J. Murr ex Druce in *Rep. botl Soc. Exch. Club Br. Isl.*, **7**: 774 (1926). TYPE: Between Poolewe and Dundonnell, W. Ross, August 1925, *G. C. Druce* (Holotype: **OXF**).

Stems markedly swollen below the basal leaves, 1–3, up to 40(–45) cm; internodes shorter, leaves and inflorescence more dense; ligules 5–7(–9) × 1–2 mm.

Distribution

v.c. 25: Shingle by the sea, Shingle Street, E. Suffolk, 2 August 1976, *P. D. Sell 76/195a* (**CGE**). Shingle beach between Aldeburgh and Thorpeness, E. Suffolk, 16 September 1975, *P.D. Sell 75/115* (**CGE**).

v.c. 27: Old dunes, Winterton Ness, E. Norfolk, 30 July 1962, *P.D. Sell 62/465* (**CGE**).

v.c. 28: Shingle between Cley Beach and Blakeney Point, W. Norfolk, 31 July 1975, *P.D. Sell 75/104* (**CGE**).
v.c. 68: Dunes by the sea, Ross Links, north of Bamburg, Northumberland, 14 July 1982, *P.D. Sell 82/142 & C.M. Pannell* (**CGE**).
v.c. 90: Dunes and sea cliffs, Arbroath, Forfar, July 1915, *G.C. Druce* (**OXF**).
v.c. 97: Shingle between Sallachan Point and Corran Ferry, Ardgour, Argyll, 30 June 1976, *P.D. Sell 76/169* (**CGE**).
v.c. 105: Mellon Charles, W. Ross, July 1926, *G.C. Druce (***OXF**). Between Poolewe and Dundonnell, W. Ross, Aug. 1925, *G.C. Druce* (**OXF**).

(b) subsp. **DUNENSIS** (Dumort.) Kadereit & P. D. Sell, **stat. nov.** *S. dunensis* Dumort., *Fl. Belg.*, 66 (1827). Described from dunes on the Belgian coast.
S. jacobaea var. *flosculosus* Lam. & DC. in Lam., *Fl. Fr.*, 3rd ed., **4**: 163 (1805). Described from dunes and sandy places in France.
Stems solitary, up to 30 (to 60) cm; peduncles often with dense arachnoid hairs; ray florets absent or rudimentary; outer achenes hairy.
Distribution
v.c. 108: Dunes by Farr Bay, W. Sutherland, 25 July 1959, *P.D. Sell 59/164, N.D. Simpson & C. West* (**CGE**). Strathy Bay, south of Strathy Point, W. Sutherland, 23 July 1982, *P.J.O. Trist 107/30/82* (**CGE**).
v.c. 111: Shell-sand, grassy pasture at seashore, near North Jetty, Copinsay, Orkney, 5 August 1933, *H.H. Johnstone 4816* (**OXF**).
v.c. H1: Banna sandhills, Kerry, July 1888, *R. W. Scully* (**OXF**). Fermoyle, Dingle Peninsula, N. Kerry, August 1955, *J.L. Farquharson* (**BM**). "Abundant on most of the Kerry sandhills, to the almost total exclusion of the rayed form" (Scully 1916).
v.c. H9: "On Aran and on most of the Connemara dunes the variant without ligulate florets predominates, but every grade of intermediate between it and the typical form is usually found nearby" (Webb & Scannell 1983, p. 115).
v.c. H12: Rosslare, Wexford, 17 September 1926, *G.C. Druce* (**BM**). Rosslare Spit, October 1980, observed by D.A. Webb & J.R. Akeroyd (J.R.A. pers. comm.).
v.c. H16: Dog's Bay, Roundstone, Co. Galway, 9 September 1955, *C.E. Raven* (**CGE**).
v.c. H27: Sandhills, Mullet, W. Mayo, July 1905 (**BM**). Dunes south of Annagh Head, Mullet peninsula, W. Mayo, 2 June 1979 (Curtis *et al.* 1981).

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Two natural hybrids in *Ranunculus* L. subgenus *Batrachium* (DC.) A. Gray

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ABSTRACT

Two natural *Ranunculus* hybrids are reported from southern Britain, whose identities have been elucidated by their chromosome numbers. The hybrid recorded from S. Hants., v.c. 11, has the triploid complement (2n = 24) consistent with the parentage *R. omiophyllus* Ten. × *R. peltatus* Schrank, whilst the tetraploid complement (2n = 32) in plants from S. Devon, v.c. 3, indicates *R. baudotii* Godr. × *R. peltatus*.

INTRODUCTION

In groups such as *Ranunculus* L. subgenus *Batrachium* (DC.) A. Gray, in which both phenotypic plasticity and hybridization are rife, unusual or intermediate plants have sometimes been dismissed as phenotypic variants of the 'nearest' species or explained away as hybrids on rather inconclusive grounds. Although chromosome numbers are of limited taxonomic value in this group (since several species exist at a number of ploidy levels, and several species share each chromosome number), there are cases in which they provide important evidence in interpreting morphological data and in resolving the identity of hybrids and intermediates (Sørensen 1955; Cook 1966; Turala & Wolek 1971). Two natural hybrids are reported whose chromosome numbers have proved useful in this context. Vouchers are deposited in the herbarium of the Botany Department, University of Reading (**RNG**).

THE HYBRIDS

R. OMIOPHYLLUS TEN. × *PELTATUS* SCHRANK FROM HOLMESLEY BOG

This plant was collected in June 1982 from Holmesley Bog in the New Forest (S. Hants., v.c. 11, GR 41/22.01), a site which has been popular with collectors of batrachian *Ranunculi* over many years and has supported at least four other members of the group including one hybrid. The most striking features of this plant are that it has laminar leaves which are very similar to those of *R. omiophyllus*, and, like this species, has lunate nectar pits, but, unlike *R. omiophyllus*, it also possesses capillary leaves and bears larger flowers (Fig. 1).

In these respects the plant resembles very closely a hybrid from Copthorne Common (E. Sussex, v.c. 14, GR 51/31.39) which was first discovered by Mr T. Hilton in 1896 and described by Groves & Groves (1901) as *R. Hiltonii* (Fig. 2). Later, Williams (1926) reported the hybrid flowering at the same site, and many specimens of it exist in various herbaria, but Prof. C. D. K. Cook was unable to re-find it at Copthorne in 1956, and concluded that it had become extinct there. A curious feature of the Copthorne hybrid was its high fertility. This was mentioned in the Groves' paper, and herbarium material studied by Cook (1966) showed nutlets with normal embryos and pollen containing about 90% of well-formed grains which were larger than those of either parent. From this evidence, Cook (1966) suggested that *R.* × *hiltonii* was an amphidiploid which had arisen from *R. omiophyllus* × *peltatus*.

In contrast, the Holmesley hybrid is highly sterile (fewer than 1% of well-formed pollen grains, and no seeds set). Mitotic root-tip squashes revealed a triploid chromosome complement (2n = 24) for this plant (Fig. 3) – the first recorded count for this hybrid. This is consistent with the parentage

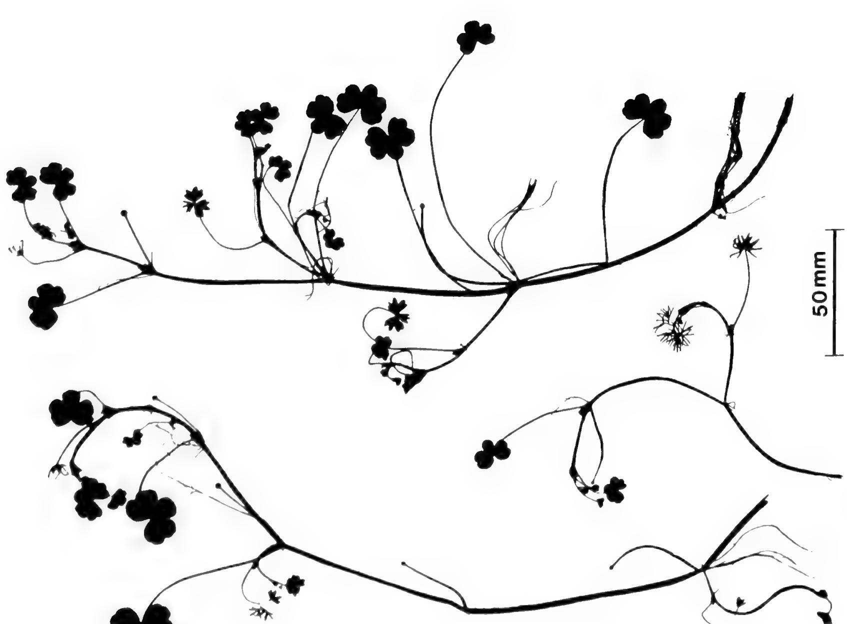

FIGURE 1. Silhouette of *R. omiophyllus* × *peltatus* from Holmesley Bog.

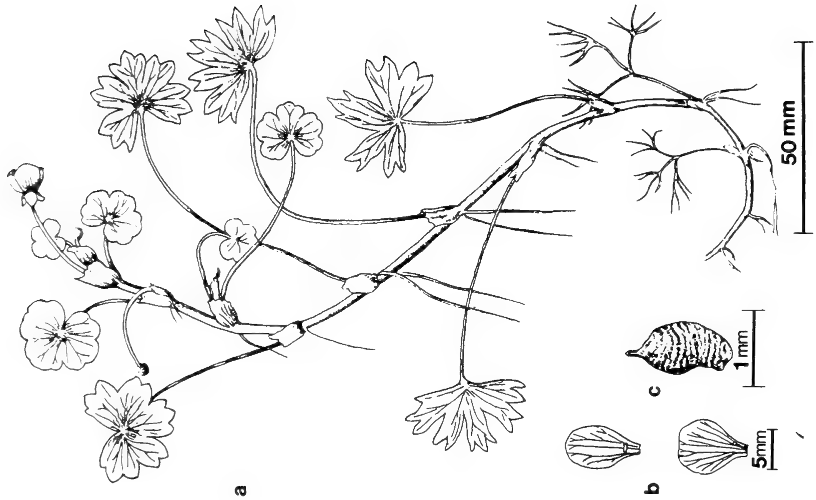

FIGURE 2. *R. omiophyllus* × *peltatus* (*R.* × *hiltonii*) from Copthorne Common, del. M. Groves from Groves & Groves (1901). a) whole plant; b) petals, adaxial view showing lunate nectar pit; c) nutlet.

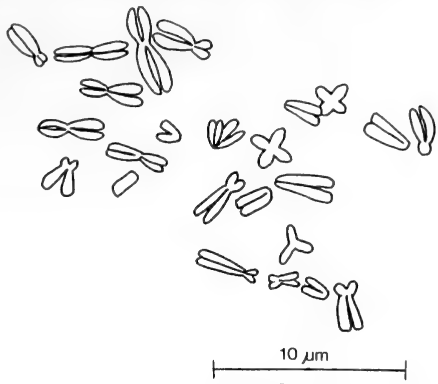

FIGURE 3. Root-tip mitosis in *R. omiophyllus* × *peltatus* from Holmesley Bog. 2n = 24.

R. omiophyllus (2n = 32) × *peltatus* (2n = 16) and it also adds circumstantial evidence supporting the hypothesis that the fertile hybrid from Copthorne was an amphidiploid (2n = 6x = 48) of the same parentage.

The Holmesley plant was found at the margin of a New Forest stream in a marshy depression in an area of closely cropped turf surrounded by heathland dominated by *Ulex europaeus* L. and *Calluna vulgaris* (L.) Hull. It is regularly disturbed by humans, horses and cattle, and supports an interesting collection of other marsh plants. Both parents were found near the site. A description of the plant is given below.

Prostrate perennial herb. Leaves laminar or divided into capillary segments. Laminar leaves opposite or alternate; petiole 30–120 mm long; lamina up to 19 mm long and 26 mm wide, reniform to sub-orbicular, with lobes narrowest at their base, margin crenate. Capillary leaves alternate; petiole 12–30 mm; lamina globose with few (15–60) segments. Segments rigid or flaccid; divergent, fine or flattened. Intermediate leaves invariably present. Stipules ovate, much resembling those of *R. omiophyllus*, adnate to petiole for half their length or less, apex obtuse. Pedicel in fruit 21–50 mm, shorter than petiole of opposed laminar leaf. Sepals up to 3 (rarely 4) mm long, spreading, caducous, green. Petals 3–8 mm long, obovate, contiguous or not; nectar pits lunate; stamens 13–20; carpels 25–43, glabrous or hairy. Receptacle hairy.

One of the most extraordinary features of this plant is that it overwinters in the heterophyllous state. Plants collected in February 1984 from the same site had laminar, capillary, and intermediate leaves.

R. BAUDOTII GODR. HYBRID FROM SLAPTON LEY

This plant was collected in June 1982 in Slapton Ley (S. Devon, v.c. 3, GR 20/82.43), a natural lake about 3 km long and 0·5 km wide that lies parallel to the South Devon coast between Torcross and Slapton and about 150 m from the sea. *R. tripartitus* DC. ("occasional"), *R. circinatus* Sibth. ("rare"), *R. trichophyllus* Chaix and *R. peltatus* (both "locally abundant") and *R. baudotii* ("occasional") were reported as occurring here in 1968 (Brookes & Burns 1979). The hybrid plant was found during an attempt to re-find *R. baudotii*. This plant (Fig. 4) is superficially very similar to the latter species, having short, rigid capillary leaves, laminar leaves which are deeply trifid, and glabrous carpels. However, the petals are atypical of *R. baudotii*, being short, broad and rounded, and, more importantly, the nectar pits are shortly pyriform: they have an upper border, unlike the simple lunate nectar pit of that species.

Presumably, *R. baudotii* is involved as one parent; *R. aquatilis* L. (2n = 48) and *R. peltatus* (2n = 16, 32, 48) are possible candidates for the other. A natural hybrid between *R. baudotii* and *R. aquatilis* is already known (Erikson 1905; Sørensen 1955), and has been found in coastal regions of England, Denmark, France and Sweden (Stace 1975). The latter hybrid is intermediate between its parents in floral and vegetative characteristics except that the sepals are blue (as in *R. baudotii*),

FIGURE 4. Silhouette of specimen of *R. baudotii* hybrid from Slapton Ley with drawing of petal showing shortly pyriform nectar pit.

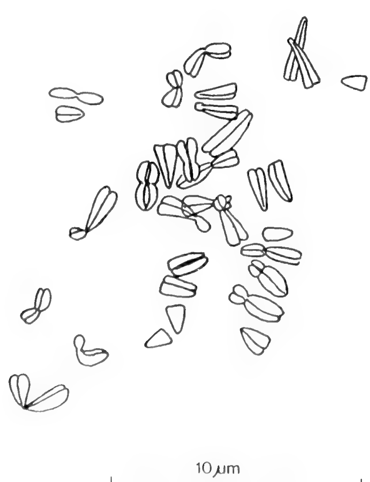

FIGURE 5. Root-tip mitosis in *R. baudotii* hybrid from Slapton Ley. 2n = 32.

the carpels are hairy (as in *R. aquatilis*), the mature pedicels are uncurved (unlike *R. baudotii*) and some leaves are morphologically intermediate between laminar and capillary. These plants are sterile and pentaploid (2n = 40). Cook (1966) reported synthesizing a hybrid between *R. baudotii* and *R. peltatus*. This hybrid looked and behaved like *R. peltatus* except that it was less vigorous, had smaller flowers and glabrous carpels and was sterile.

The Slapton plant differs morphologically from these hybrids. Male fertility, estimated by percentage of well-formed pollen grains, was high (90% or more) and the nutlets were well formed and germinated readily. Mitotic root-tip squashes revealed a tetraploid chromosome complement (2n = 32) for this plant (Fig. 5). These observations suggest that *R. peltatus* (2n = 32) and not *R. aquatilis* is involved with *R. baudotii* in the parentage of this hybrid. However, this plant differs from the synthesized hybrid of the same parentage described by Cook, and no natural hybrid of this identity has apparently been previously reported. *R. baudotii* has recently been reduced to a subspecies of *R. peltatus* (Cook 1983).

This plant was found on the eastern side of the Ley, in 'bays' in the *Phragmites* fringe, where the water was about 0·5 m deep. A number of other interesting plants were found here, including *Lemna minuscula* Hert., *Potamogeton pectinatus* L., *Chara connivens* Salzm. ex A. Br. and the coenobial green alga, *Hydrodictyon*. A description of the plant is given below.

Erect annual herb. Leaves laminar or divided into capillary segments. Laminar leaves opposite or alternate; petiole up to 60 mm long; lamina up to 15 mm long and 20 mm wide, reniform with brown markings, deeply 3-lobed, lobes cuneate, margin crenate. Capillary leaves alternate, shorter than internodes; petiole 1–10 mm long; lamina 25–35 mm long, globose to obconical. Segments 35–80, fine, usually rigid but some flaccid. Intermediate leaves occasionally present with capillary portion of leaf proximal. Stipules triangular, adnate to petiole for 0.75 or more of their length, apex acute. Pedicels up to 160 mm long, longer than the petiole of the opposed laminate leaf. Sepals c.3 mm long, caducous, brown-tipped. Petals 3–5 mm long, broadly ovate. Nectar pits shortly pyriform, with an upper border. Stamens 13–26. Carpels (25–)40–55(–72), glabrous. Receptacle hairy.

DISCUSSION

Cytological data – in this case, chromosome numbers – may provide useful evidence in *Ranunculus* subgenus *Batrachium* in the context of unusual hybrid and intermediate plants. Such evidence can be particularly valuable since hybrids in this group are often not morphologically intermediate between their parents, and hybrids derived from reciprocal crosses often differ. In some cases, parental features are inherited very unequally whilst the hybrid may exhibit new features not seen in either parent. Cytological data are needed for many other plants of unknown identity in the group.

ACKNOWLEDGMENTS

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Watsonia, **16**, 31–36 (1986)

The distribution of *Poa angustifolia* L. in Britain

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ABSTRACT

Data collected during a survey of British Rail land included a total of 232 new 10 km square records for *Poa angustifolia* L. The biology of the plant is considered in relation to the railway environment, and reasons for the extended distribution pattern are discussed.

INTRODUCTION

Poa angustifolia L. is considered native to Britain (Clapham *et al.* 1981; Hubbard 1968), although information about its distribution is incomplete (Barling 1959; Hubbard 1968). Unless in flower the plant is inconspicuous, and at a glance may be taken for *Festuca rubra* L. Its taxonomic position has been uncertain and, in some vice-counties, it has not been recorded as a separate species or even as a segregate of the *P. pratensis* L. group.

In Britain, Hubbard (1968) gave habitat information as "rough hill grassland, especially on chalky and limestone soils, frequently growing among tufts of *Bromus erectus*". Grime & Lloyd (1973) described the species from limestone grassland, whilst Barling (1959) found the grass most commonly with *Brachypodium pinnatum* (L.) Beauv., *Bromus erectus* Hudson and *Avenula pubescens* (Hudson) Dumort. Of 135 British Floras consulted (bibliography at Monks Wood Experimental Station), 49 included information about *P. angustifolia*. The habitats described are grouped and listed in Table 1, and the number of times each habitat is mentioned is given. Some Floras mention more than one habitat. Similarly, records held at the Biological Records Centre, Monks Wood Experimental Station (B.R.C.) were tabulated and all those giving habitat information are also included in Table 1. Many recorders did not include such information, and absolute frequencies are not, therefore, calculated. Herbarium sheets held at **BM** and **K** were also examined, and habitats recorded on these were found to correspond closely to the breakdown given in Table 1 (most of the **K** records are duplicated by B.R.C., and therefore contribute to Table 1).

Semi-natural habitats are freely-draining soils (usually calcareous) supporting coarse grassland or woodland (often beech), sand, gravel and shingle, although several collections at **K** were from wet, heavy soil. These plants tended to have at least some leaves from sterile tillers wider than 2 mm. More artificial habitats include roadside verges, walls, wasteland, docks and airports. Two herbarium sheets labelled "London bomb-site flora" were found. However, the most common habitat recorded is railways.

The oldest specimen examined was collected by J. Dickson between 1789 and 1791 (**BM**), and was recorded from woodland, the only habitat seen listed on herbarium sheets prior to 1850. No locality is given for this or for a woodland collection made by Pelham in 1797 (**K**). The earliest railway specimen was collected in 1897 by S. T. Dunn from near Rugby and was obtained through the Watson Botanical Exchange Club for herb. A. B. Jackson at **BM**. The first roadside record, also in herb. A. B. Jackson at **BM**, is dated 1910.

Amongst the Floras examined, the railway habitat is first mentioned by Hanbury & Marshall (1899). In the *Bedfordshire plant atlas* (Dony 1976), the distribution map is annotated "railway banks", and elsewhere Dony (1953) suggested the grass may have been sown.

TABLE 1. HABITATS GIVEN IN FLORAS AND ON BIOLOGICAL RECORDS CENTRE CARDS

Habitat	Floras[1]	B.R.C.[2]
Chalk grassland, downs, escarpments	17	11
Sand dunes, pits, warrens	4	7
Heaths (dry acid soils)	5	2
Woodland	11	9
Hedgerows, dry banks	16	5
Railway verges	14[3]	28
Roadside and motorway verges	11	26
Docks, airports and wasteland	9	9
Gardens, parks, allotments	2	7
Walls, pavements	8	19
Quarries, gravel, shingle	3	4
In shade	3	4
Near water	1	3

[1] A total of 135 British Floras were examined (list at Monks Wood Experimental Station): *Poa angustifolia* was mentioned in 49.

[2] All 10 km sq records for *P. angustifolia* held by B.R.C. were examined. Habitat information was given on only 110 cards.

[3] The references listing railway verges as a habitat for this species are: Benoit & Richards 1963; Bowen 1968; Cadbury *et al.* 1971; Dony 1953, 1967, 1976; Ellis 1983; Graham *et al.* 1972; Hanbury & Marshall 1899; Kent 1975; Messenger 1971; Roberts 1982; Roe 1981; Stearn 1975.

P. angustifolia is common in two noda of the *Arrhenatheretum* found along railway lines (Sargent 1984a). The relevant part of the synoptic table is reproduced (Table 2), and shows frequent associates together with recorded abundance. The grass is common on warm, freely draining slopes, either with *Brachypodium pinnatum* and *Bromus erectus* (mean pH 7·8), or with *Festuca rubra*, *Achillea millefolium* L. and *Plantago lanceolata* L. (mean pH 7·3). In both noda, *Arrhenatherum elatius* (L.) Beauv. ex J. & C. Presl, *Dactylis glomerata* L. and *Rubus fruticosus* agg. are abundant, reflecting the character of the rough, calcicolous, railway grasslands.

It is very likely that the nodum in which *B. pinnatum* is constant at level V (more than 80% of samples) is comparatively recently burnt grassland with little nutrient in the soil (Green 1983), whilst that in which *F. rubra* attains the same level has not been burnt for some time. When data collected on separate occasions from the same sites in Southern and Western Regions of British Rail were analysed and modelled to show change, a marked increase in the area of *F. rubra* grassland was found, and this was associated with changes in management: controlled sward burning had been almost completely abandoned in these Regions with the demise of steam engines and consequent reduction in fire hazard from engine box sparks. However, chemical weed control of a narrow (3 m) strip adjacent to the track bed, introduced to replace systematic management of the whole verge, has not proved entirely adequate, and it is likely that verge burning will increase in future.

DISTRIBUTION

During a survey of British Rail land, *P. angustifolia* was found in a total of 316 × 10 km squares (sites within 646 squares were surveyed). In 232 of these the plant had not previously been recorded. These data considerably extend the known range of *P. angustifolia* from south-eastern Britain into the north and west. A distribution map is shown in Fig. 1. Eight-figure grid references, community and habitat data are held at Monks Wood.

The British Rail land survey was completed under contract with the Nature Conservancy Council: objective data were collected from a total of 721 sites, each consisting of 100 m of track, randomly distributed within 26 geographic strata covering the entire rural network, and from a further 243 areas visited to document their biological interest. *P. angustifolia* was recorded from 430 of these locations.

TABLE 2. FREQUENT ASSOCIATES AND RECORDED ABUNDANCE OF *POA ANGUSTIFOLIA* WITHIN DEFINED NODA (SARGENT 1984a) OF THE *MOLINIO ARRHENATHERETEA* ON RAILWAY LAND

	Nodum 1	Nodum 2
Poa angustifolia	IV (1–5)	II (1–2)
Arrhenatherum elatius	V (1–5)	IV (1–5)
Dactylis glomerata	IV (1–5)	III (1–4)
Poa pratensis	III (1–5)	II (1–3)
Rubus fruticosus	III (1–5)	III (1–5)
Plantago lanceolata	V (1–3)	II (1–2)
Centaurea nigra	III (1–5)	III (1–4)
Lathyrus pratensis	II (1–4)	II (1–3)
Heracleum sphondylium	II (1–4)	II (1–2)
Festuca rubra	V (1–5)	
Rumex acetosa	II (1–2)	
Holcus lanatus	II (1–5)	
Taraxacum officinale	II (1–2)	
Achillea millefolium	IV (1–2)	
Leucanthemum vulgare	III (1–4)	II (1–4)
Cerastium fontanum	II (1–2)	
Equisetum arvense	II (1–4)	
Potentilla reptans	III (1–5)	
Vicia sativa subsp. *nigra*	II (1–4)	
Lotus corniculatus		II (1–3)
Brachypodium pinnatum		IV (3–5)
Bromus erectus		II (1–5)
Cirsium arvense		III (1–4
Convolvulus arvensis		III (1–5)
Festuca arundinacea		II (1–4)
Viola hirta		II (1–3)
No. samples	215	54
Mean pH	7·3	7·8

Constancy: II = 20–40%; III = 40–60%; IV = 60–80%; V = >80%.
Cover: 1 = <2%; 2 = 2–5%; 3 = 6–20%; 4 = 21–50%; 5 = >50%.
Nomenclature follows Tutin *et al.* (1964–1980).

DISCUSSION

Railway banks are comparatively warm (Suominen 1969) and are engineered to be freely draining (Sheail 1979). The verges are untrampled and are grazed by small mammals and invertebrates only. In the past, they have been managed by annual or more frequent mowing and burning. Only selective herbicides, including 2,4–D and Picloram, have been used on verges, and spraying is restricted to a strip approximately 3 m wide adjacent to the track bed. Spent ballast and cinders are commonly tipped along slopes, and may imitate sand, gravel and shingle. Nitrogenous wastes from trains drain into the cess and down embankments (Sargent 1984b).

Xeromorphic summer leaves (Barling 1965; Galkin & Seredin 1973; Sukhova 1974) enable *P. angustifolia* to compete successfully in this environment. Although grazing response has been variously reported (Ammar 1978; Barling 1959; Bublienko 1980; Grime & Lloyd 1973; Osichnyuk & Panova 1978; Tkachenko *et al.* 1979), it is likely that the absence of heavy grazing is advantageous, and certainly, on untrampled railway slopes, the thin, wiry rhizome (Khoang T'yung 1975; Tuganaev & Pestereva 1976) is not at risk. Further, the rhizome may be important in recovery from burning. Early flowering and seeding (Prokudin *et al.* 1982) may have favoured *P. angustifolia* when verges were mown or scythed annually; the selective herbicides at present in use

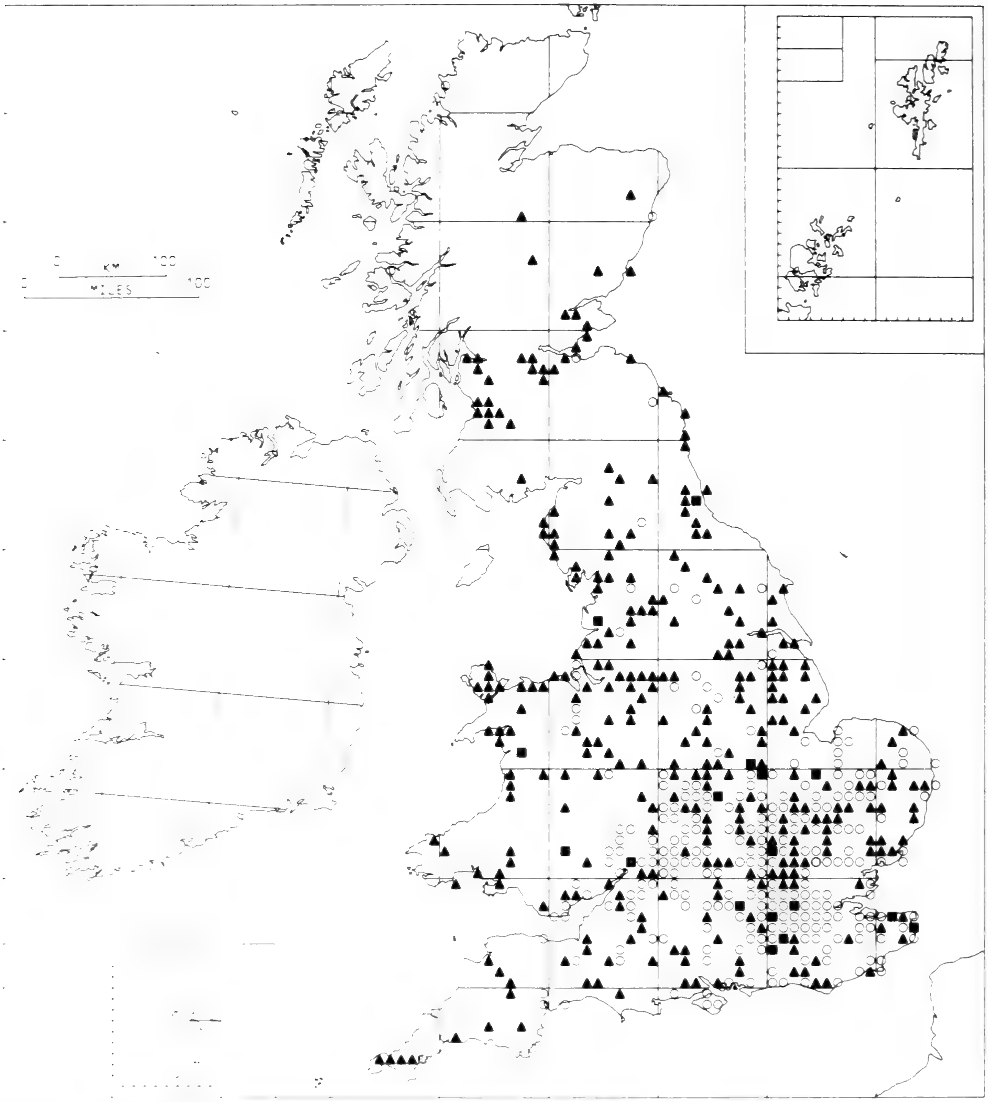

FIGURE 1. Distribution map of *Poa angustifolia* in Great Britain. The data are plotted from 805 records occurring within 570 10-km squares. The British Rail land survey provided 430 records covering 316 10-km squares, 232 of these are squares in which *P. angustifolia* had not previously been recorded. ▲ = British Rail land survey; ■ = other railway data; ○ = other data (for some of which no habitat information is available). Railway data are plotted in precedence over other data.

are unlikely to produce permanent damage (Shikhotov & Kuchin 1975). This combination of habitat and management favours the establishment of *P. angustifolia* on railway land.

The very marked clustering of previous records in south-eastern Britain indicates that, despite the limitations in previous recording introduced by variable taxonomic treatment, the present distribution pattern shows an extension of range into suitable, albeit man-made, habitats.

It is clear, however, that railway land, because access is restricted, has been under-recorded. What is less clear is the status of *P. angustifolia* in Britain. Is it really a native species of downland

and beech hangers in the south-east? Or has it been introduced with grass seed and spread via railway lines and roadside verges to other suitable habitats? The majority of previous records from Scotland are from ports (Fig. 1), and the plant is known from docks and airports (Table 1).It may have arrived as a cargo alien: M. McCallum Webster annotated material (**K**) from Selkirk "introduced, with wool shoddy". However, the earliest records, dating from the late 18th century (before railways were built) are from woodland, and it is likely that at least part of the population is native.

A genecological study could be most interesting. Because the species is largely apomictic (Åkerberg 1939; Löve 1948) it is possible that populations from different sources have maintained some genetic integrity, showing a preferred distribution of chromosome numbers. However, the very wide range of numbers reported (Bolkhovskikh 1969; Edmondson 1980; Löve & Löve 1961; Majovsky *et al*. 1972) and the occurrence of different numbers in the same sward (collections by Hubbard at **K**), indicates that the situation is complex.

The railway is often very distinct from surrounding land, especially in north-western Britain. Its continuity has enabled a number of species more commonly associated with warm, dry, southern habitats to extend their range: *Daucus carota* L. and *Rosa stylosa* Desv. are amongst other good examples (Sargent 1982), and the phenomenon is certainly not unique to *P. angustifolia*.

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A reconsideration of the taxonomic status of *Poa balfourii* Parnell (Gramineae)

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ABSTRACT

Poa balfourii Parnell (Gramineae) has held the doubtful status of species since Parnell described and discussed it in 1842. Observations by the author on wild populations of *Poa glauca* suggest that the plant, successively described by Parnell (1842), and discussed by Sowerby (1872) and Hubbard (1968), is a distinctive variant of *Poa glauca* that may not merit formal taxonomic recognition.

INTRODUCTION

Poa balfourii was first described by Parnell (1842). He named it after Dr J. H. Balfour of Glasgow University, who had collected the type specimens from Ben Voirlich, Mid Perth, v.c. 88, in 1842. Parnell stated that it was closely allied to *Poa nemoralis*, whilst Sowerby (1872) referred to its similarity to *P. glauca* Vahl but noted that it was less rigid and less glaucous, and lacked the bluish tinge of *P. glauca*. Hubbard (1968) considered it to be closely related to *P. glauca* and very similar to a mountain variety of *P. nemoralis* L., and added "a rare imperfectly known mountain grass". Tutin (1952) considered the taxon only briefly and commented that it was similar to *P. glauca* but differed "in the short truncate ligule". *P. balfourii* was not recognized by Edmondson (1980).

Among the many herbarium specimens that I have seen mislabelled "*P. balfourii*", both *P. glauca* and *P. nemoralis* are commonly found. Many 19th century herbarium sheets of *P. balfourii* were annotated with alternative determinations, together with comparative notes on the similarity of the taxon to the numerous species and varieties of montane *Poa* then recognized; and the species has often been subsumed within one or other of these, e.g. *P. nemoralis* L. var. *balfourii* (Parn.) Hook. f. and *P. glauca* Vahl subsp. *balfourii* (Parn.) Syme.

A factor complicating the variation pattern is facultative agamospermy. *Poa nemoralis* and *P. glauca*, together with *Poa palustris*, form section *Stenopoa* and are facultatively agamospermous. Gustafsson (1946) said of section *Stenopoa* that "morphologically they stand rather close . . . no diploids exist and the whole complex is polyploid and apomictic". He noted that the variation occurring in *Stenopoa* is very wide: crosses between species frequently take place and there is a "difficulty in correctly demarcating them". He added a further complication when he stated that "members within the section certainly hybridize with one another and also with polyploids out of other sections". The evolution of apomictic groups is associated with polyploidy, as seen in the multiple chromosome number recorded in *P. nemoralis* and *P. glauca*, which is some indication that polyploidy is a source of new variation in this group. There is variation in the outline of the panicle, the number and length of spikelets, the colour and the distribution of colour over the whole plant and the rigidity of culm and blades. The consequent variation in an environmentally heterogeneous area is sufficient to obscure the taxonomic distinction between *P. nemoralis* and *P. glauca*. Ecological variants that have been assumed to be genetic variants have been recognized as species, such as *Poa montana*, *P. polynoda* and *P. balfourii* itself. This paper, based on my field observations since 1969, assesses the taxonomic status of *P. balfourii*.

THE SEARCH FOR *POA BALFOURII*

I started to look for *Poa balfourii* in 1969 in Snowdonia, to which area I returned in 1979. During the intervening years of the 1970s I searched mica schist crags in the Killin area of Mid Perth, v.c. 88, to follow up old records. My study was directed to areas facing north, and from north-east to south-east, in habitats of partial shade, total exposure and varying shelter.

Throughout this period I sent many specimens of putative *P. balfourii* to the late Dr C. E. Hubbard, all of which he referred to "the mountain variants of the polymorphic *Poa nemoralis*". Nevertheless, he encouraged my search and begged me to find him plants of *P. balfourii* to bring into cultivation. Earlier, in 1958, Hubbard (in litt.) had noted that "*P. balfourii* is generally separable from *P. glauca* by its lax often nodding or inclined inflorescence, but here again further study of the two in Britain is required". Hubbard remained in doubt and (pers. comm. 1972) said "these mountain *Poa*'s are much in need of critical study in the field and the experimental ground". I continued my field studies, but it was clear to me that he was never quite satisfied with the status of *P. balfourii*.

VARIATION IN *POA GLAUCA*

Poa glauca in Britain is found both in fully exposed positions and in sheltered habitats at altitudes of c. 670–920 m. It is essentially a grass of cliffs and rocky slopes, and is less usually found on screes. The fully exposed habitat is seen on small ledges on vertical rock faces, in small pockets on flat protruding rocks and occasionally on an isolated rock fallen from a cliff. These sites, where there are often no abutting rocks on either side or above, are completely exposed to wind and rain. *P. glauca* would appear to occupy a dry habitat but most of its stations occur where there is an overhead source of water, or are on a rocky slope receiving water from above. These sites of extreme exposure probably represent the most common habitats of *P. glauca*.

More sheltered habitats are found in mini-corries and rocky gullies running to the base of cliffs, which offer varying degrees of shelter and certainly afford a less stringent environment than the exposed cliff-face. Within these areas are small sites which are sheltered from the wind on one or more sides, and where an additional element is shade. The sites generally face east, north-east or south-east and experience a very limited amount of direct sunshine.

In rocky habitats, *Alchemilla alpina* appears to be the most common associate, with *Saxifraga aizoides*, *S. oppositifolia*, *Silene acaulis* and *Festuca vivipara* as frequent associates; occasional associates within a metre square include *Alchemilla glabra*, *Cerastium alpinum*, *Galium boreale*, *Oxyria digyna*, *Polygonum viviparum*, *Euphrasia* spp., and *Deschampsia caespitosa*. It is unusual to find more than three or four associated species at any one site, as the limited size of the habitat only allows the development of a small community. The habitat is similar to that of *P. alpina* L.

Hubbard (1968), in his description of *P. glauca* said "it is covered with a whitish wax" and that this distinguished it from *P. balfourii* and *P. nemoralis*. This would seem to give taxonomic standing to a feature modified by the environment. My observations on the occurrence of this whitish wax is that it only occurs on *P. glauca* in exposed positions and that there is no trace of this feature on *P. glauca* in shade and shelter. The same applies to the deep mauve colouring that is found only on plants in exposed situations, when most of the culm, the base or up to half the length of the blades, and the whole of the length of the sheath, is a deep mauve, and the spikelets are a dark green with tinges of deep mauve and often with a gold or bronzed tip. In situations where there is some adjacent rock shelter, the mauve colouring is modified in extent and shade of colour. In fully exposed sites the rigidity of culm and blades is a feature, but in shade and shelter the rigidity of culm and blade is absent; the panicle is loose and nodding and the colour of the whole plant is grey-green, light green or even sometimes a dark green. The deep mauve colour of culm, blades and sheaths is reduced to a light mauve zone c. 1 cm in length at the base of the culm. While the spikelets are devoid of mauve colouring, they are occasionally found with a light gold tip. As I hope to show in the following discussion, it is these shade variants that have formerly been treated as a separate species, *P. balfourii*.

RELATIONSHIP OF *POA BALFOURII* TO *P. GLAUCA*

The diagnostic characters given for *P. balfourii* by Parnell (1842) were as follows: "Florets slightly webbed. Ligule prominent, obtuse. Upper leaf nearly as long as its sheath. Outer palea 5-ribbed. Stem compressed".

The "webb" of the florets (silky hairs of the lemma keels), is extremely variable in length and density and often almost absent in *P. glauca*. In the shade variant of *P. glauca*, the webbing is sparse as described for *P. balfourii*. The ligule is not always prominent but always obtuse. The ligule of *P. glauca* of shade and exposure has a range of 0·8–3·0 mm but the upper limit beyond 2·5 mm is uncommon.

The relation of the length of the upper leaf to the length of the sheath in *P. glauca* is also very variable. The upper leaf of the culm is frequently as long as or longer than its sheath. Parnell gave the outer palea (lemma) as 5-ribbed, a feature which he also attributed to *P. caesia* (*P. glauca*). With regard to the compressed stem character, it is found that the culm of the shade variant of *P. glauca* may be compressed, nearly round or almost square-sided.

Sowerby (1872) described *P. balfourii* in detail, in much the same manner as Parnell, but also gave no measurements. He distinguished it from *P. glauca* in that the plant was "not rigid as in *P. eu-glauca*: the ligule is longer and the whole plant less glaucous and without the bluish tinge of *P. eu-glauca*". This is a fair description of the shade variant of *P. glauca*.

Hubbard (1968) gave a full description of *P. balfourii*, supported by measurements. He described it as "a loosely tufted perennial . . . culms erect, leaves greyish green . . . ligule blunt, the uppermost 1–3 mm . . . panicles loose, inclined or usually nodding 4–10 cm long; spikelets 5–7 mm greyish green, glumes finely pointed". Hubbard said it is "very closely related to *P. glauca*" which he said "has stiffer culms, firmer blades, stiffly erect and usually open panicles". These attributes apply to the *P. glauca* of exposed habitats. The details of Hubbard's description of *P. balfourii* perfectly matches that of *P. glauca* of shade and shelter, except for the extreme of the range of measurements of both ligule and spikelet, which are uncommon.

Further evidence of the identity of *P. balfourii* comes from a study of the probable type specimens. The type specimens of *Poa balfourii* in **E**, on sheets *87/83*, *8* & *9* from Ben Vorlich, 1842, named *P. balfourii* by Parnell, have been annotated as "no doubt one of the original specimens". The specimens on both sheets have light green spikelets with gold tipped lemmas, and in my opinion are shade variants of *P. glauca*.

COMPARATIVE MEASUREMENTS OF *POA BALFOURII*, *P. GLAUCA* AND *P. NEMORALIS*

A range of measurements of *P. glauca* and those attributed to *P. balfourii* are given in Table 1. A comparison of the measurements of the various parts of *P. glauca* and *P. balfourii* given by Hubbard (1968) and my own records of *P. glauca* of exposed and shaded positions, respectively

TABLE 1. MEASUREMENTS OF *POA BALFOURII*, *P. GLAUCA* AND *P. NEMORALIS*

	Hubbard (1968)		*P. glauca*[a]		
	P. balfourii	*P. glauca*	Of exposure	Of shade & shelter	*Poa nemoralis*[a]
Height, cm	15–40	14–40	(9–)15–25(–34)	(25–)27–32(–40)	(18–)25–30(–50)
Blade length, cm	3–8	2–8	(2–)2·8–5·0(–5·5)	(3·5–)6·0–8·5(–10)	(1·5–)2·5–7·0(–10)
Blade width, mm	2–3	2–4	(0·5–)1·0–2·0(–2·6)	(1·3–)1·7–2·5(–2·8)	(0·7–)1·0–2·0(–2·3)
Upper ligule length, mm	1–3	1–2·5	1·7–2·5	0·8–2·5(–3·0)	(1·5–)3·0–10·0(–12·0)
Panicle length, cm	4–10	2–10	(1·2–)2·0–6·0(–7·0)	(4·0–)6·0–8·0(–9·5)	(2·2–)3·0–5·0(–6·0)
Spikelet length, mm	5–7	4–6	(2·5–)3·0–4·5(–6·3)	(3·5–)4·0–5·8(–6·0)	(2·0–)2·5–3·0(–3·6)
Lower glume length, mm	3–4	3–4·5	(2·5–)2·8–3·8(–4·2)	(2·6–)2·8–3·5(–4·0)	(2·0–)2·5–3·5(–3·8)
Upper glume length, mm	3·5–5	3–4·5	(3·0–)3·3–4·5(–4·7)	(3·2–)3·5–4·0(–4·7)	(2·5–)3·0–3·5(–3·8)
Lemma length, mm	3·5–4·5	3–4·0	(3·0–)3·5–4·0(–4·6)	(3·3–)3·5–4·3(–4·6)	0·2–0·5

[a] Measurements made by P.J.O.T. on c. 150 plants (250 culms) from both the field and the herbarium.

show no significant taxonomic differences. Two measurements only call for comment and these, which have been previously mentioned, relate to *P. balfourii*. They are the upper range of the ligule (3 mm) and the spikelet (7 mm). These upper limits do occur but are unusual. The range of the lengths of the spikelets, glumes and lemmas given by Hubbard (1968) for *P. glauca* and *P. balfourii* and those of mine for *P. glauca* of exposure and shade, are comparable respectively.

The plant height in all four taxa shows that plants of exposure can be up to 6 cm shorter than those of shade. Of the length of blades, my measurements show a slightly greater length from plants in shade compared with those of exposed sites; the width of blades shows 0·8 mm less in the lower range in exposure.

The number of spikelets per plant of *P. glauca* has a range in exposed sites of (5–)10–20(–26), and in shade of (4–)10–28(–34). The number of spikelets may have no significance and is possibly influenced by habitat and available nutrients, but within the range of the sample we are also probably looking at hybrid variants. The lowest branches of the panicle number 1–2 and 3 is uncommon in both exposure and shade. The length of the branches is variable, 5–14 (–18) mm in exposed sites and 7–18 (–22) mm in shade; the variation is not an unusual feature.

The variation in the height, rigidity of culm and number of spikelets did not escape the observation of Parnell (1842). Under *P. balfourii* he described a var. *rigida* Parn. as a "short stout variety . . . with a simple panicle of few spikelets". An 1842 specimen on sheet *74/84,2* (**E**) from Ben Vorlich was recorded as *Poa balfourii* var. *rigida*. It has a ligule of 2·5 mm and is a typical, small specimen of *P. glauca*, with rigid culms and blades which I have already described from exposed sites and which is confirmed by Parnell (1842) "found in exposed situations". He also described a var. *extensa* as a "tall and slender variety with a simple panicle of few spikelets", the *P. glauca* of shade.

From Table 1 we can also compare the measurements of this shade variant of *P. glauca* (*P. balfourii*) with those of *P. nemoralis* from the mountain. The height range of the two taxa is similar and relates to local environment. For the length of the culm blades, the upper range of measurements is similar. In the lower scale, *P. nemoralis* appears smaller but in this sample it is influenced by small specimens of *P. nemoralis* var. *coarctata*; the same may be said of the width of the blades. In the range of panicle lengths, *P. nemoralis* shows a wider variation and the small panicles of the sample of the var. *coarctata* have influenced the lowest length of 1·5 cm; both the size and outline of the panicle of both taxa are extremely variable in relation to environment. In the lengths of the spikelets of both taxa the range of each is almost identical, but in *P. nemoralis* it is slightly smaller. In general, *P. glauca* produces fewer spikelets than *P. nemoralis* and some of the spikelets of the lower branches of the latter are often depauperate. A comparison of the length of the glumes and lemma shows little more than a 0·5 mm difference. The significant difference in the morphology of the two taxa lies in the shape and length of the ligule: in *P. glauca* the ligule is 0·8–2·5(–3·0) mm and obtuse and in *P. nemoralis* it is 0·2–0·5 mm and truncate. In addition, the shape of the glumes in the latter is long-pointed and lanceolate and in the former pointed and ovate-elliptic, but these shapes are variable.

RELATIONSHIP TO *POA NEMORALIS*

Hubbard (1968) echoed Parnell's protologue by stating that "in its form of growth, *P. balfourii* is very similar to the mountain variety of *P. nemoralis* with rather large spikelets, differing mainly in its longer conspicuous ligules". This "mountain variety" similarity leads us to consider the montane variants of *P. nemoralis*.

Many varieties of *P. nemoralis* have been described and in the present context I shall only refer to some which I consider to be recognizable. Two varieties are more or less exclusively lowland, var. *vulgaris* Gaud. of woodlands and var. *angustifolia* Parn. of shade and hedgerows, and need not be considered. Var. *glaucantha* (Gaud.) Reichenb. and var. *coarctata* Gaud. are both found on mountain crags, but also in the lowlands, the former in woodland clearings and the latter on walls. I have also noted var. *montana* Gaud. in herbaria and I have attempted to match specimens of this variety with plants from the mountains. It is very variable in colour, in the outline of the panicle and number of spikelets, which have a size-range of 3·3–6·0 mm. The ligule is 0·5 mm long. In fact, all of these varieties of *P. nemoralis* have a common diagnostic factor in the shape and length of the ligule, which is truncate, often with a pinched point in the centre facing the leaf, and is 0·2–0·5 mm long – the two hallmarks of *P. nemoralis*.

Hubbard (pers. comm. 1972) said that "a longer liguled *P. nemoralis* has been called var. *montana* or var. *parnellii*" and I believe his reference was to *Poa montana* Parn. (*P. nemoralis* var. *montana* Koch) which Parnell (1842) described with a "conspicuous obtuse ligule". An 1887 specimen (**CGE**) has a 3 mm ligule; it was gathered on Creag an Lochain, Killin, labelled *Poa montana* by C. C. Babington, and referred to *Poa balfourii* by Arthur Bennett. This long-liguled *Poa montana*, referred to *P. balfourii* and confused with a mountain variety of *P. nemoralis*, is a variant of *P. glauca*.

A collection by E. S. Marshall labelled *P. balfourii* from Garbh Beinn, no. *1649* (**CGE**), has been annotated by Hackel: "This is so near to what in our Alps we call *P. nemoralis* var. *montana* that I can find no marked difference". On the same sheet, Hackel also referred to Marshall's 1896 collection from Aonach Beg, no. *1648*, and named *P. balfourii* var. *montana*, which he said "only differs from no. *1649* by its longer ligule . . . so that probably no clear line can be drawn between *P. balfourii* and the alpine forms of *P. nemoralis*". Hackel's note continues, ". . . and shall often meet with specimens which must remain doubtful, or in which it will depend more upon the skill of the observer than upon real positive characters". This appears to be an indirect reference but an undisclosed admission that "the skill of the observer" should include observations on the habitat.

There is a further problematic variant which I have seen on a number of occasions in N. Wales and in Scotland. In general appearance it is more like *P. nemoralis* than *P. glauca*: it is lax, with its spikelets generally nodding, and does not exhibit the rigidity of leaf and culm of *P. glauca* growing in exposed sites. Its glumes are long and narrow as in *P. nemoralis* and unlike the ovate-elliptic glume of *P. glauca*. The ligules are 0·5–0·8 mm and obtuse. Are these variants of *P. glauca* × *P. nemoralis* or variants of one or other taxon? These plants are surely those which Hubbard often quoted to me as "the mountain variant of the polymorphic *P. nemoralis* with slightly longer ligules". That mountain variants of both *P. nemoralis* and *P. glauca* exist cannot be disputed, but variants with ligules >0·5 mm cannot be accepted as *P. nemoralis* and are variants of *P. glauca*.

TAXONOMIC CONCLUSIONS

Poa glauca and *Poa nemoralis* are morphologically similar, and the taxa frequently present problems of separation. In *P. glauca* the glumes are long-pointed and ovate-elliptic, and in *P. nemoralis* generally lanceolate and sometimes almost ovate, and variants are found where the differences are blurred. There are therefore occasions when the distinction between the two taxa can only be resolved on the shape and length of the ligule.

Field observations on the ecology of *Poa glauca* have shown that plants are found in a range of situations from extreme exposure to shade and shelter, which induces a variety of phenotypes. The slender variant of green-coloured *P. glauca*, with no covering of whitish wax and without any deep mauve coloration, usually found as a single-culmed plant in the shade and shelter of rocks, is that montane *Poa* variant to which the name *Poa balfourii* Parnell has been given. It is considered therefore that *P. balfourii* has been incorrectly treated at the level of species, and that it is merely an infraspecific variant of *P. glauca*. Whether its particular morphology is a genotypic or a phenotypic response to its shade environment is unknown.

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The distribution, ecology, history and status of *Gastridium ventricosum* (Gouan) Schinz & Thell. in the British Isles

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ABSTRACT

Gastridium ventricosum (Gouan) Schinz & Thell. (Nit-grass) is a native of south-western England and occurs as a casual in the Channel Islands. From herbaria and manuscript records, it appears that it has been recorded from 34 vice-counties in Britain over the past 200 years. Few records have been reported since the publication of the *Atlas of the British Flora* (Perring & Walters 1962). At the request of the Nature Conservancy Council, a field survey of its current status was carried out in July and August 1980, 1981 and 1982. Habitat descriptions, plant associates, estimated populations, soil textures and conservation status were recorded.

INTRODUCTION

Perring & Walters (1962) give dots for records of *Gastridium ventricosum* in 107 10 km squares for pre-1930 and 18 post-1930 records for England and Wales and two in the Channel Islands. With three exceptions, all records were south of the Wash and 98% were south of the line between the River Severn and the River Blackwater. Hubbard (1968) records that it is "probably native in short grassland on limestone and chalk: elsewhere a weed of arable land, occasionally locally abundant in corn fields on light or heavy soils". Perring & Farrell (1977) report "At one time it was recorded from about 28 vice-counties extending as far north as Yorkshire, though it was undoubtedly only casual in many inland stations. Since 1960 it has only been reported from six localities in Cornwall, Dorset, Somerset, Hampshire, Gloucestershire and Glamorgan, and from Guernsey and Sark".

The current native sites of *G. ventricosum* are found in short virgin grassland on limestone or soils derived from limestone. It can no longer be regarded as a weed of arable land. As such, in 1980 it was only known in a small arable area of S. Hants., v.c. 11 (Trist 1983). Considering its isolation in the native sites, it is unlikely that we shall see many more casual plants.

METHODS

Inquiries on the location of known sites were made from members and county recorders of the B.S.B.I. Old records in herbaria were examined, together with numerous county Floras and other manuscripts. Many arable sites which have been recorded in the past 50 years in southern England have been recently surveyed. The last known records from vice-counties have been listed. Soil samples were taken within and without the area of $2m^2$ quadrats to a depth of c. 10 cm. For pH determination, dry soil was treated with a soil indicator containing bromothymol blue and methyl red. The method does not match the accuracy of the use of the glass electrode but it does give an indication of a pH range, which is given in the text.

DISTRIBUTION

Perring & Walters (1962) show that *G. ventricosum* formerly had a wide distribution over the southern half of Britain. The greater majority of these records were referable to arable colonists and casuals. The author has only been able to trace 22 records since 1950, of which 50% were casuals or colonists.

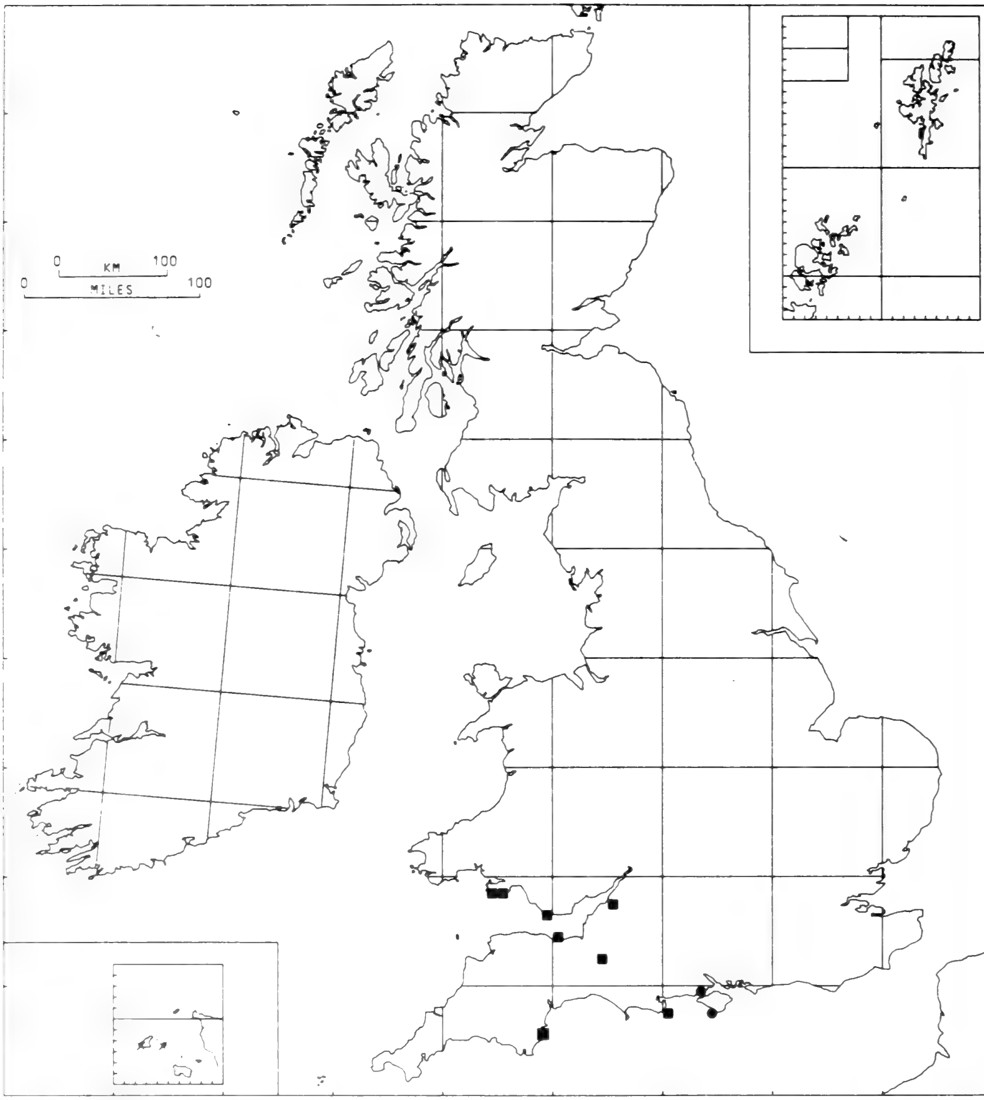

FIGURE 1. Distribution of *Gastridium ventricosum* in the British Isles, based on the author's 1980–82 survey. ■ native sites; circles denote arable colonists and casuals.

The field surveys of 1980–82 have revealed two facets in the history of the distribution of this grass. Firstly, its former status as an arable colonist is almost lost and will inevitably disappear. Secondly, there are a number of native sites on coastal downland, which have previously only been recorded on one or two occasions and some which have not been previously recorded. The records of 1982, compared with those of 1960, are predominantly native.

Recent fieldwork reveals that *G. ventricosum* occurs in only nine vice-counties, in 11 10-km squares with 36 sites in 24 1-km squares. In southern Wales there are five sites in the Gower Peninsula and one near Cardiff. In England there is one site in North Somerset, three in South Somerset, one in South Devon, ten in Dorset, two in West Gloucestershire and one in the Isle of Wight. In South Hampshire, there are five sites of arable colonists. In the Channel Islands there

TABLE 1. *GASTRIDIUM VENTRICOSUM* LOCATIONS

Vice-County	Location	Grid (10 km)	Aspect	Slope	Distance from sea km	Altitude m	Habitat*
3	South Devon	20/9.5.	SE	30°	0·10	60	G
5	South Somerset A	31/0.4.	S	20	0·5	60	G
	South Somerset B	31/0.4.	SE	20	0·8	45	G
	South Somerset C	31/0.4.	S	20	0·8	30	G
6	North Somerset	31/4.2.	SSW	20	20·0	50	G
9	Dorset A	40/0.7.	S	10	0·25	60	G
	Dorset B	40/0.7.	S	10	0·25	60	G
	Dorset C	40/0.7.	SSW	40–60	0·19	30	G
	Dorset D	40/0.7.	S	30–55	0·19	30	G
	Dorset E	40/0.7.	S	25–30	0·25	83	G
	Dorset F	40/0.7.	S	30	0·25	170	G
	Dorset G	40/0.7.	S	10	0·03	100	G
	Dorset H	40/0.7.	S	5	0·20	100	G
	Dorset I	40/0.7.	S	30	0·20	100	G
	Dorset J	40/0.7.	S	20	0·20	100	G
10	Isle of Wight	40/9.7.	S		0·003	5	C
34	Clifton A	31/5.7.	SSE	15–20	8·0	100	C
	Clifton B	31/5.7.	SSW	35–40	8·0	30	C
41	Gower A	21/5.8.	SSE	30	0·95	50	G
	Gower B	21/4.8.	SSW	30–35	0·35	30	G
	Gower C	21/4.8.	WSW	20–25	0·09	35	G
	Gower D	21/4.8.	ESE	20	0·10	35	G
	Gower E	21/4.8.	S	15	0·85	40	G
	Nr Bridgend	21/9.6.	S	35–40	0·40	40	G
11	Lymington A	40/3.9.	Level arable		0·05	<3	A
	Lymington B	40/3.9.	. .		0·50	<3	A
	Lymington C	40/3.9.	. .		0·50	<3	A
	Lymington D	40/3.9.	. .		0·50	<3	A
	Lymington E	40/3.9.	. .		1·80	<3	A
S	*Sark*						
	La Collenette	WV/4.7.	S		0·92	98	R
	By School	WV/4.7.	S		0·47	100	R
	By Chapel	WV/4.7.	N		0·92	104	R
	Mill Lane	WV/4.7.	W		0·14	94	R
	La Coupée	WV/4.7.	S		0·80	98	R
	Near Mill	WV/4.7.	W		0·70	102	R
	Guernsey						
	Le Douit, St Peter's	WV/3.7.	S		1·00	15	R

* Habitat key: G, Grassland; A, Arable; C, Cliffs; R, Ruderal.

are six sites in Sark and one in Guernsey: these have not been seen by the author but the sites, soil and plant associates indicate that the plants are casuals.

Fig. 1 shows the distribution of *G. ventricosum* in the British Isles plotted from the 1980–82 survey by the author. Table 1 gives the location, aspect and slope of the habitats and the distance from, and the height above, the sea.

PHENOLOGY

G. ventricosum is an annual grass with a life cycle spanning twelve months. It sets seed in September–October and germination takes place in six to eight days. Within 14 days of germination, the single-leaf seedling is 1–1·5 cm long. In the first winter of this work, it was

TABLE 2. *GASTRIDIUM VENTRICOSUM*: SIZE OF PLANTS IN DIFFERENT HABITATS

	Native plants		Arable colonists
	Downland	Rabbit grazed	In wheat
Height, cm	5–50	1·5–9·5	37–97
Spike length, cm	2·5–8·5	0·5–2·7	3·5–16·5
Blade length, cm	0·5–6·5	0·3–2·7	4·5–20·0
Ligule length, mm	0·5–3·2	0·5–1·6	2·0– 4·2

recognized that seedling development would be subject to climatic conditions of habitat. From November to April 1980–81, a night frost was recorded on 58 occasions at Balsham, Cambridge, of which 21 were in February. In the autumn of 1980, seeds were sown in pots at Balsham and, during the above period, most of the seedlings in pots were either directly killed or unseated by frost: this climate would not have been experienced in a native coastal habitat.

In cultivation, the single leaf growth remained static until late April and remained slow until late in the spring. By mid-May, the characteristic leaf curl developed and in the following three weeks into June there was a gradual acceleration of tillering up to early July, when the spikes broke the sheath. The long period of low temperatures, when a range of 1–10°C of frost was recorded, would have retarded leaf development until late April.

From year to year it appears that spike exsertion may take place any time from mid-June to mid-July. D. E. Coombe (in litt. 1980) reported anthesis from plants in Dorset on 29th June 1952 and, following a mild winter at Balsham in 1983–84, I recorded first spike exsertion on 19th June. Coombe (in litt. 1984) reported spike exsertion in the Avon Gorge on 6th July and, from my survey of 1980–82, I found exsertion from the first to the third week of July. The variation in date of spike exsertion is at least partly due to variation in the date of germination, which is influenced by climatic conditions. Seed sown at Balsham on 24th March 1981 produced plants which exserted spikes after 23rd September. The late period of growth of this grass is marked. In the Gower Peninsula in August 1980, fresh green spikes had developed on new branches of a culm where the primary spike had already gone to seed.

The culm has a final height range according to habitat, and detailed measurements are given in Table 2. In an open association of grasses and herbs, the height varies between 5 and 40 cm; and where an open sward has the occasional low gorse bushes or hawthorn on the perimeter of the *G. ventricosum* colony, the several influences discussed in the notes on native habitats will increase the height to c.50 cm. The height of the arable colonist plants varies between 37 and 97 cm and is often about twice that of the average downland plant and is related to both height and density of the wheat crop; and no doubt there is also some growth response from fertilizers applied to the wheat. Culms are frequently branched even among the smallest plants, but rarely so in the tall arable plants.

ECOLOGY

SOILS AND GEOLOGY OF THE NATIVE SITES

The soils to be described were taken from a depth of 10–15 cm. The Somerset sites are found on isolated deposits derived from the Rhaetic Limestone which is a junction-bed between the Lower Lias and the Keuper Marl; they contain inter-bedded limestone beds and clay or shale. At one, the soil is a chocolate-brown silty clay loam with a low clay fraction. The soil aggregates are up to 2·5 cm across and break readily into fine granules and contain small rounded fragments of hard limestone and red-brown shale. At another, the soil is similar and is a grey-brown silty clay loam with a low clay fraction. The aggregates are up to 1·3 cm across, breaking readily into fine granules and contain fragments of limestone and grey shale. At both sites, the soils contain fibrous roots and are stable to water.

At the Dorset sites the soil is a brown silty clay loam with a low clay fraction and overlies the

Purbeck Limestone. Much of the area has in the past been shallow quarried and outcrops of rock and small stones are much in evidence on the surface. It was difficult to uncover a profile and the interpretation of a halt to an auger may be a large stone or flat stone platform. Much loose rock is encountered and soil depth may vary from 10–60 cm. On a higher part of this area, soil depth is very shallow and most augerings indicate c.10 cm over hard limestones. The silty clay loam samples comprised mainly small aggregates of 1–5 mm of angular fragments with partly rounded edges and angular blocks of 1–2 cm across, together with flat limestone flakes of 3–10 mm. These soils wet slowly, are stable to water and are free-draining.

On the cliffs of the Avon Gorge and on the Gower coast, the soils overlie Carboniferous Limestone. At the former sites, the soil is a red-brown sandy loam with granules up to 2 cm across. At the latter, the texture is more or less similar but three of the sites have more fine sand and one a little more clay. The aggregates break easily, are stoneless and contain many fibrous roots; they wet easily and are stable to water.

The soil descriptions clearly have much similarity and are considered to be from native sites of *G. ventricosum*. No soil at any site showed any evidence of wetness or indication of impeded drainage. The aggregates have a good granular structure, break readily and are friable, making a good open medium for root growth. All sites are on slopes where rainfall has a steady run-off and, with good drainage, less calcium is leached or being made soluble.

The soil samples taken from each site show that, with two exceptions, the pH range of 6·5–7·0 is common to all sites: the exceptions being 7·8 at the Clifton A site and 8·3 at Clifton B (Lovatt 1981). The soil is naturally well drained on all of the native sites and is shallow, c.10 cm, and in the absence of rainfall, soon becomes dry. The breakdown of plant remains is mainly by insects and under dry conditions they become the main agents in preventing acidity. Woodlice were recovered from the Dorset and Somerset samples. Trist (1983) has recorded variation in soil pH tolerance by *G. ventricosum* in arable from 5·8–6·5 and as low as 5·0–5·8 in a local condition in an old stackyard.

THE NATIVE HABITAT

Many records in county Floras erroneously give the impression that *G. ventricosum* is native in arable and woodland margin habitats. In the literature dating back to the 19th century there is scarcely any mention of our native sites or descriptions of our native habitats. Trow (1911), recording for Glamorgan, had no knowledge of native plants in the county which had been collected by *Groves*, 1903 in **BM**, **OXF** and **NMW**, and *Riddelsdell*, 1907 in **BM**. This latter record and that of *Druce*, Monknash Cwm, 1929, together with *White*, Clifton, 1912, all refer to sites as native but give no specific description of the native habitat. It appears that only four of the 22 native sites now known were recorded prior to c.1912 and the only native sites which had any attention were in the Avon Gorge.

There are features of habitat which are common to all native sites of *G. ventricosum* in England and Wales. There is an open sward of short calcareous grasses and herbs. The soil has good drainage properties and the texture only varies slightly from a silty clay loam to a sandy loam. The depth is shallow and frequently overlies rock. The surface, often littered with loose stones, has rock exposure and is open to the wind which contributes to erosion. The sites are on slopes, some of which are steep, or often on the brow of the slope. Such areas have well defined transverse tracks or sections of exposed bands of rock, adjacent to which the ground is bare through climatic and rabbit erosion. The slopes are in general facing south and normally in close proximity to the sea or a tidal estuary.

At most of the Dorset sites, the rabbit is the conservationist and, in its absence, there would be considerable change in the open grassland conditions. *G. ventricosum* occurs in small patches of broken ground between stones and surface rocks where the turf is heavily grazed and eroded by rabbit scratching. It only grows to a height of 1–8 cm between patches of open, non-aggressive grasses. On one Dorset site, a grass enclosure presented a varied habitat: small gorse was dispersed and there was little broken ground. Three small sites of *G. ventricosum* were found where the soil depth was c.10 cm, while over most of the enclosure there was a depth variation up to 60 cm. Gorse was at each site and had been periodically controlled by fire. This retards the gorse in the first year and allows an open area for the autumn germination of *G. ventricosum* which later attains a height of 15–20 cm; but where germination has taken place below the gorse, the seedlings have to compete with the gorse recovery and the light factor gives growth up to 47 cm.

In the Gower Peninsula, a site on a slope overlooking the sea had a shallow soil with rock exposure. The calcareous sward had scattered small gorse which had been fired. In the open sward, *G. ventricosum* of 12–18 cm high had no competition with its associate grasses but, within gorse patches, its height doubled to 18–38 cm.

The taller plants of *G. ventricosum* within gorse areas may, in part, be attributed to the light factor but in these coastal gorse habitats the height may also be influenced by gorse management. The habitat is frost free but exposed to wind and sea spray. In the micro-climate between gorse cover, there is less exposure to wind and variation in temperature. Where gorse is periodically fired there would be an increase in available phosphorus from the gorse ash in the top few centimetres of soil and a release of nitrogen from the breakdown of nodules on the gorse roots. This small addition of P and N could make some contribution to the growth height of *G. ventricosum* found within areas of low gorse, which at 10 sites have been noted to occupy 25–65% of ground cover in $2m^2$.

At the Somerset sites, the slopes have much broken ground largely due to weathering. The broken ground provides the open requirement of *G. ventricosum*, in spite of *Sanguisorba minor* making some ground cover and *Hypericum perforatum* creating low shade and competition. On the margin of the colonies of this grass there were hawthorn, blackthorn and dog-rose, 1·5–2 m high (1980). At a metre distant from the scrub, *G. ventricosum* was 15 cm high and, under scrub shade, it had grown out to the light to 43 cm high. Similar growth has been recorded on wheat headlands; where this grass is in competition and deprived of light it will grow to 97 cm (Trist 1983). There is a big difference between the 55 cm height of gorse in the Gower and the 2 m height of hawthorn at the Somerset sites, but the deprivation of light has a similar effect on the growth of *G. ventricosum*.

If scrub is not controlled, there is a gradual loss of habitat caused by the advancing growth of parent scrub and seedlings. While *G. ventricosum* can withstand some light deprivation, responding by increased growth height, colonies adjacent to expanding scrub move their ground to more open sites. At one of the Somerset sites it is likely that an extension of the *G. ventricosum* area has occurred over a number of years, during which time the scrub has increased its growth following the abandonment of livestock grazing. Recorders in the past have noted fluctuations in site populations and positions. While the climatic influence on seed production is of great significance, this is only one facet. The survival of populations is dependent on seed germination in an open habitat and this latter is more important. In 1981, R. G. B. Roe (in litt.) reported "there was a good crop this year again in the same general area but not specifically in the same places as in 1980".

WOODLAND HABITATS

Where *G. ventricosum* has been recorded from woodland margins and rides, it can only be considered as a short-lived casual introduction. This is supported by herbarium sheet annotation. As examples we have "borders of a wood, Twine Hills, near Wells", 1883, sheets in **CGE** and **BM**; and "a clearing in woodland, near Buck's Green, Sussex", 1941, sheets in **BM** and **K**. In the former, the wood border record is giving the impression of a habitat but the site no doubt refers to an arable headland bordering a wood. In the latter, it is known that there are arable lands on either side of the wood. There seems little doubt that the grass was introduced on boots or on wheels from the arable land. The only record for Yorkshire is from a ride in Brocodale Wood, Wentvale, 1937, recorded by W. A. Sledge who considered it a gamekeeper's introduction.

THE ARABLE HABITAT

The movement of *G. ventricosum* seed from its native habitat and its establishment as a colonist in arable cultivation is discussed by Trist (1983). All of the features of the native habitat are absent from the arable habitat.

Although this grass as an arable colonist is now only known in South Hampshire, it was formerly reported from many counties some 50–150 km from the sea. In arable land it survives under very different conditions and there is no preference for slope or aspect. It has been found in a wide range of soils from light gravel sands to heavy clay, which in turn have poor to satisfactory drainage. Its tolerance to a lower pH has been recorded. Its arable weed associates are naturally different from those of its native grassland. Probably the most significant native habitat factors are the maximum light requirement and an absence of plant competition; under cereals both of these factors are restricted, especially during the early phases of establishment. The author has surveyed a large number of cereal crops from Dorset to Surrey where *G. ventricosum* was formerly reported: in all fields, the crop density made it impossible for this grass to survive and no plants were seen.

SALT TOLERANCE

A feature of the habitat of *G. ventricosum* is proximity to the sea. In the majority of sites, this has been found to be between 30 and 100 m, although one Somerset site is 500 m and another 20 km from a tidal estuary. Many of the cliff sites are subject to sea spray and there is evidence that this grass has a tolerance to a low degree of salinity. To the east of Lymington, plants were found in arable land which had recently been flooded with sea water and had good growth (Trist 1983). This area may be the reference given by Johns (1893) under *Gastridium lendigerum* "growing in fields near the sea occasionally overflowed in the south of England". Other saline habitat records include "sea shore near Brighton" *J. Hardy*, 1840 (in **MANCH**) and Hanbury & Marshall (1899) record "edge of low marshy ground above the sea shore", Eastwear Bay, Kent; these sites could have been subject to high tides. Swete (1854) records in the tidal Avon Gorge, "side of the river below Cook's Folly"; White (1887) records that it was refound on the "bank of Avon" by W. E. Green prior to 1882.

THE PLANT ASSOCIATES OF *G. VENTRICOSUM*

The associated species set out in Table 3 do not include species occurring less than four times. The total species recorded at 22 native sites was 110. The records from the Rhaetic Limestone show numbers of less than half those recorded from the Purbeck and Carboniferous Limestone, but it is known that the species on the former were under-recorded. The species list reflects a dry, well drained, calcareous soil which is common to all sites. *Sanguisorba minor* occurred in 18 sites, *Thymus praecox* subsp. *arcticus* in 13 and *Koeleria macrantha* and *Pilosella officinarum* in 11 sites. Where *G. ventricosum* can be presumed to be native, the site is generally species rich. Some of the associated flora is rare and is exemplified by *Althea hirsuta*, first found in 1875 near one of the Somerset sites and refound in 1950 in a similar habitat of "open stony pasture" (Roe 1981). Further examples of other interesting species are found in *Ophrys sphegodes, Linum bienne* and *Gentianella anglica* in Dorset; *Bromus madritensis, Potentilla tabernaemontani* and *Rubia peregrina* in the Avon Gorge; and the last two species which also occur with *Scilla verna* in the Gower. The associated flora of the arable colonist *G. ventricosum* included *Agrostis gigantea*, *Cirsium arvense*, *Polygonum aviculare* and *Veronica persica*, a collection of arable weeds which reflects the alien habitat.

BRIEF HISTORY OF RECORDS

The earliest known record of *G. ventricosum* in Britain is given by Ray (1688), "near Tunbridge Wells, Kent", found by a Mr Doody who assisted Ray with his *Synopsis* and *Historia Plantarum*. There is no account of the habitat but, 200 years later, Wolley-Dod (1937) recorded "locally plentiful in cornfields between Tunbridge Wells and Eridge Rocks, 1883". In 1726, Dillenius found at Norton St Philip "in a field sown with trefoil", the first record for North Somerset. There are no further early records until we have the first from North Devon at Woodbury and Cornwood, 1784 (Martin & Fraser 1939); the first record in the Avon Gorge is by Dyer, 1789 "near the New Hotwell, Clifton" (Shiercliff 1789) and Mansel-Pleydell (1895) gives the first record for Dorset as 1799.

Since about 1850 up to modern times there have been very few records described from native habitats, but there has been much recorded error in describing arable land and woodland as native habitats. Perhaps with the exception of the Avon Gorge, there has been no continuity of records in the 34 vice-counties in which *G. ventricosum* has been recorded; and only two to three records per county are known for 14 vice-counties, which were widely dispersed from Herefordshire to Yorkshire. The distribution illustrates the movement of the cereal colonist by seed corn transportation. The recognized seasonal fluctuation in the germination of this grass would also lead to the abandonment of search for records. Over the period 1850–1950 there were considerable fluctuations in the national acreage of cereals and, where *G. ventricosum* had become established in arable land, there would be frequent loss of the habitat by land going down to grass. In the past 30

TABLE 3. RELATIVE FREQUENCY, USING THE DOMIN SCALE OF COVER ABUNDANCE, OF PLANTS IN 2×2 M QUADRATS AT 22 NATIVE *GASTRIDIUM VENTRICOSUM* SITES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Dactylis glomerata	3	4			3	2	5	5	6	4	4	1	8	7	3	1	2	2	3	3	2	2
Sanguisorba minor	6	5					1	5	1	4	4	5	2	2	3	1	4	4	3	2	2	1
Plantago lanceolata	4	5			3	5	4			2		3	7	3		3	3	3	3	3	1	1
Festuca ovina			2	2					5	7	6	5	10	5				4	4	4	3	3
Thymus praecox subsp. *arcticus*		2	2					1	1	4	2	4	3	4				3	3	2		2
Holcus lanatus					3	3	2	4	2		3		3	4			2	1			2	1
Bellis perennis	1	5						2	5	2	4	1	4	3					2	1		
Koeleria macrantha			2	2				1	2	1			6	5				1	4	3	2	
Pilosella officinarum			2	2					3	3	4	4	7	3				1	3	4		
Centaurium erythraea		2	2					1	1	2	2	2	2			4						
Ulex europaeus					8	6	8								7		5	4	1	4	2	5
Agrostis stolonifera						3	3	2	4			1	6				4	3		1		
Brachypodium sylvaticum		2			1	3	3	2				5					1	1				3
Carex flacca							1		2			2	5	3			3	2			1	1
Cynosurus cristatus	3	3				2	1	3	6			1	4	4								
Leontodon taraxacoides					3	4	2	3			1	5	3	8					2			
Linum catharticum			2	4					1		2		3			1			2	2	1	
Trisetum flavescens	3	4	2			2	2	3			2				3			4				
Anagallis arvensis	1	1											3				4	1	2	1	1	
Galium verum								2		4	3		3	9				2		3	1	
Helianthemum nummularium															3	1	2	4	3	3	2	3
Lotus corniculatus									3		3	2				1	1	1		1	2	
Daucus carota	2				3	4	3		1					3				1				
Festuca rubra subsp. *rubra*									2	8			7	5				2			1	
Salvia horminoides		1	1						2			1	2	2								
Senecio jacobaea								1	2				3	3			1	1				
Brachypodium pinnatum									2	2	4		3	4								
Bromus hordeaceus subsp. *hordeaceus*		1				1			2		3		4									
Cerastium fontanum subsp. *triviale*						2			1		1			2								
Desmazeria rigida		2														1		1			2	1
Medicago lupulina							1	9								4					1	1
Rubia peregrina															3	4	3				1	2
Danthonia decumbens																	3	2	1	5	1	
Agrimonia eupatoria							1	1			1											1
Anthoxanthum odoratum																	1	3		2	1	
Blackstonia perfoliata		2	1							1	1											
Bromus hordeaceus subsp. *ferronii*									5	1	1		3									

TABLE 4. *GASTRIDIUM VENTRICOSUM*: LAST KNOWN RECORDS IN VICE-COUNTIES, 1823–1979

Vice-county		Location	Source	Habitat	Year
Pembs.	45	?	*J. L. Knapp*, **BRIST**	arable	1824
E. Norfolk	27	Gillingham & Cley	Smith (1824)	arable	1823
Hunts.	31	Monks Wood, Abbots Ripton	*A. Fryer*, **OXF**	arable	1882
Caerns.	49	Aber	*A. Ley*, **BM**	waste	1886
E. Kent	15	Staplehurst	*E. S. Marshall*, **BM**, **BRIST**, **OXF**	arable	1893
Merioneth	48	Aberdovey	*D. A. Jones*, in MS *Flora of Merioneth*, **NMW**	waste	1907
Selkirks.	79	Galashiels	*I. M. Hayward*, **OXF**	waste	1916
Scilly	1b	Old Town, St Mary's	H. Downes, in Thurston & Vigurs (1922)	roadverge	1922
E. Cornwall	2	Nr. St Austell railway station	W. Tresidder, in Thurston (1929)	waste	1928
Surrey	17	By the Way & Arun Canal	*J. E. Lousley*, **RNG**	arable	1936
S.W. Yorks.	63	Brocodale Woods, Wentvale	*W. A. Sledge*, **herb. W.A.S.**	woodland	1937
N. Essex	19	Gosfield	*C. E. Hubbard*, **K**, **OXF**, **herb. E. C. Wallace**	arable	1939
Herts.	20	Near Cowheath Wood, Bayford	S. Phelp, in Dony (1967)	arable	1946
N. Devon	4	Northam Burrows	Wright (1949)	waste	1948
S. Essex	18	West of Hadleigh Castle	*E. C. Wallace*, **K**, **OXF**, **herb E.C.W.**	grassland	1950
W. Suffolk	26	Lakenheath	*J. E. Lousley*, **BM**	waste	1952
W. Kent	16	Chattenden Wood	*F. Rose*, **MNE**	woodland	1954
W. Sussex	13	Between Crawley & Horsham	*B. Welch*, **BM**	arable	1954
Herefs.	36	Eywas Harold Common	*F. M. Day*, **K**	waste	1955
Worcs.	37	Evesham	*C. W. Bannister*, **BM**	waste	1958
Mons.	35	Near Raglan	E. K. Horwood, B.R.C. field record	arable	1958
Warks.	38	West of Alcester	*M. Clarke & J. Kiernan*, **WAR**	arable	1960
E. Suffolk	25	Clapper Farm, East Bergholt	*P. H. Raven & J. F. M. Cannon*, **BM**	grassland	1961
Beds.	30	Ampthill	*H. J. M. Bowen*, **K**	waste	1962
W. Cornwall	1	Trelissick Gardens, King Harry	B. E. M. Garratt, no voucher, Margetts & David (1981)	wall	1979

years there have been very few reports of *G. ventricosum* but an understanding of the native site has been developing while the arable colonist has been disappearing. Apart from the last remaining arable colonist stronghold in the Lymington area, where this grass has been known for over 100 years, there has been only one recent report of an arable colonist: "arable between Preston and Osmington, Dorset", *B. Marcan*, 1972 in **BM**. This record from arable land was adjacent to a cliff path where H. J. M. Bowen recorded a native site in 1955. The improved technology of cereal production has by its crop density made it impossible for this grass to continue to thrive in the cereal habitat (Trist 1983). The modern study of the native habitat has led to increased observation within areas where sites have previously been recorded. While there are still relatively few known sites, this grass can be found with large populations.

The last known records of *G. ventricosum* from 25 vice-counties over the period 1823–1979 are given in Table 4.

CLIMATIC INFLUENCE ON PLANT POPULATIONS

The average annual rainfall at the rain gauge stations nearest the *G. ventricosum* sites is given in Table 5 and shows a significant variation in its range of 752–1178 mm. From records of height growth and plant populations recorded at the native sites, there is no indication that either of these factors are influenced by total annual rainfall.

Lovatt (1981) records that the Avon Gorge populations have mainly been found in unshaded,

TABLE 5. ANNUAL RAINFALL AVERAGES FOR 1941–1970 TAKEN FROM THE NEAREST APPROPRIATE RAIN GAUGE STATION TO THE *GASTRIDIUM VENTRICOSUM* SITES AND ADJUSTED FOR ALTITUDE DIFFERENCE

Location		Rain Gauge Station		Average Annual Rainfall
Site	Altitude m	Site	Altitude m	mm
N. Somerset	50	The Grange, Somerton	32	752
S. Somerset	60	Chapel Cleeve	27	793
Avon Gorge, W. Gloucs.	30–100	Oakfield Road, Clifton	61	851
Dorset	50–100	Panorama, Swanage	37	906
S. Devon	54	Rea Barn Road, Brixham	50	950
Gower Peninsula, Glam.	30–50	Penmaen	87	1178

south-facing rocky habitats, prone to desiccation. The 'rocky habitat' is common to most of the known native sites and, as the grass has continued to survive in this habitat, it is some indication of its ability to withstand dry conditions. This is further exemplified by Lovatt when he comments that long droughts and high temperatures, causing moisture deficit, kill out competitors to the advantage of *G. ventricosum*: the resulting bare ground provides an opportunity for the survival of more plants in the following season. However, where this grass is associated with scrub, a dry year may have some affect on other grasses and herbs but not very much effect on scrub seedlings and the increase in *G. ventricosum* plants in the following year, encouraged by bare ground, may be temporary. In the end, the advance of scrub defeats this grass, not by deprivation of moisture but by crowding out and excessive shade, in fact by the loss of essential open habitat.

Lovatt in the same paper says "that lack of rain is the most important weather factor but long periods of sun and high temperature are also required". The question of amounts of rain and periods of sunshine has to be related to the seasonal demands in the development of the plant. It is the relative absence of rain in a hot dry summer which gives the right conditions for good seed production and some amount of rain in the autumn to encourage germination.

If the climatic conditions for seed production can be met, then the extreme exposure of native cliff habitats, which are frost free, can be tolerated, and if rabbits are present, the loss of some seedlings by grazing or disturbance is compensated by grazing control of other plants and seed burial.

If a grazing site is abandoned, such as is the case at one Somerset site, and runs to scrub, long grass and herbs, the chance of existing populations surviving in later years will not only depend on climatic influence but on grass and scrub control by man and animal. At the same site in 1980, there was a colony of 18 *G. ventricosum* plants spread over 30m^2 on a steep slope with broken ground and with 2m high thorn scrub creating a fair amount of shade. At an adjacent site 35 m along the slope where the grass was much shorter, the herbs smaller and there was no scrub, there was a colony of 70 plants in 0·25 m^2. This discussion follows the conditions required for the maintenance of a population, give or take the annual differences caused by 'climatic influence': a good or poor seed year. It does not explain the very wide annual variations in populations which occur.

Of 22 native sites, all but three are less than 1 km from the sea and this affinity appears as a strong feature in the habitat requirement of this grass. Two of these three sites are in the Avon Gorge, and both are 8 km from the sea. One of the Somerset sites that probably represents the eroded remains of a cliff, is now some 20 km from the sea. It is of interest to consider that in Britain, *G. ventricosum* is probably at its northern limit in the south-west and prefers a mild coastal habitat. By contrast, in early July 1983, the author found this grass at Le Chateau Bonaguil in Lot-et-Garonne which is c. 100 km from the tidal estuary of the R. Garonne. This surprise is explained if we turn to Rouy (1913) who records a wide distribution "dans une grande partie de la France".

Table 6 gives population estimates of *G. ventricosum* at 24 native sites in Britain. The causes of the variation in populations from site to site are manifold.

TABLE 6. POPULATION ESTIMATES AT 24 NATIVE SITES OF *GASTRIDIUM VENTRICOSUM* IN BRITAIN

Locality	V.c.	Estimated number of plants	Year
Clifton B	34	4	1980
Dorset F	9	15	1981
Dorset G	9	20	1981
Is. of Wight	10	20	1982
Gower D	41	20	1980
Gower E	41	25	1980
Clifton A	34	25	1980
Dorset A	9	25	1980
Dorset J	9	30	1980
S. Somerset A	5	45	1980
Dorset I	9	65	1980
Gower C	41	80	1980
S. Somerset B	5	100	1982
S. Somerset C	5	100	1982
Dorset B	9	100	1981
Nr. Bridgend	41	100	1982
Dorset H	9	110	1980
N. Somerset	6	150	1980
Gower B	41	155	1980
Gower A	41	330	1980
Dorset D	9	730	1980
Dorset C	9	870	1980
Dorset E	9	1000+	1981
S. Devon	3	1000+	1983

CONSERVATION

The conservation status of *G. ventricosum* is generally satisfactory. Most sites are off the beaten track, often in areas of rough walking, and have some difficulty of access, which would deter the average rambler. It can therefore be said that public pressure is not a problem.

The Dorset sites are wardened and the rabbit is allowed to survive and act to advantage as a grazier. Sites with encroaching hawthorn and those with gorse do present a threat to habitats, but some control is being exercised. At the Somerset sites, in the absence of livestock grazing, animal droppings and inorganic fertilizers, the phosphorus status is lowered and unchecked hawthorn and dog rose is encouraged. However, at one site, some action has been taken recently by the County Trust for Nature Conservation and plans are in hand to control scrub at another.

Gorse is a frequent associate of *G. ventricosum* but, on the coastal habitats of the Gower, there has been a time-honoured custom of burning the gorse annually or at least every 2–3 years. An additional control is the fact that sites are on shallow soils over rock, so that growth height and total cover is checked. Also in the Gower, there is control of reversion to rough grazing by sheep. On one of the Dorset sites, a large ungrazed enclosure has three colonies of *G. ventricosum* associated with gorse. The latter is to be controlled and cattle grazing re-introduced.

The small colony on a cliff face in the Isle of Wight is probably made up of colonists from a native site further back on the slopes, not yet found. The site is in danger of wind and wave erosion and no action can be taken.

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Observations on the morphology and fertility of *Juncus* × *surrejanus* Druce ex Stace & Lambinon in north-western Wales

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ABSTRACT

The range of morphological variation of hybrid plants from a number of different populations of *Juncus* × *surrejanus* Druce ex Stace & Lambinon (Juncaceae) in north-western Wales is described. The variability of the hybrid is compared with that of its parent species, *J. acutiflorus* Ehrh. ex Hoffm. and *J. articulatus* L., growing in the same localities. The production of viable (i.e. germinable) seed by this hybrid, as found in many of the *J.* × *surrejanus* populations investigated, is reported for the first time from British plants, which had previously been described as seed-sterile.

INTRODUCTION

The hybrid *Juncus acutiflorus* Ehrh. ex Hoffm. × *J. articulatus* L. was first found by W. H. Beeby in Surrey in 1882 (Beeby 1884). Specimens sent to F. Buchenau for his opinion were tentatively identified as "*J. lamprocarpus*, Ehrh., var. *macrocephalo* affinis", but with the further comment that they were "more likely a hybrid between *lamprocarpus* and *acutiflorus*." Beeby, however, having observed the plant during a second season, was impressed by its complete failure to produce seed and its intermediacy in some respects between the two species. Consequently, in the following year, he sent a further gathering of specimens to Buchenau (Beeby 1885) and at the same time drew his attention to the constant sterility of the plant. To this Buchenau replied that "from the form of the perianth, and from your observations, probably = *J. acutiflorus* × *lamprocarpus*." This hybrid was listed as "× *Juncus Surrejana* Dr." by Druce (1929) but the name *Juncus* × *surrejanus* Druce ex Stace & Lambinon has only recently been validated (Lambinon & Stace 1983).

Cytological evidence was obtained by Timm & Clapham (1940), who showed that while *J. acutiflorus* had a chromosome number of $2n = 40$ and *J. articulatus* $2n = 80$, the plants they had identified as the hybrid had $2n = 60$ and a study of meiosis in these plants confirmed their hybrid origin. Further chromosome counts of $2n = 60$ for this hybrid have been obtained by Zandee (1981) from various localities in western Europe.

Although Timm & Clapham found that *J.* × *surrejanus* was very common in the Oxford area, subsequent records of it in the British Isles have been very uneven. A recent map of its distribution in Wales (Ellis 1983), for example, shows a preponderance of records in Merioneth, v.c. 48, where it has been recognized in many places by Benoit & Richards (1961), but only a very thin sprinkling of records elsewhere. This is possibly because identification of the hybrid is not always as straightforward as the published descriptions suggest. Whilst Timm & Clapham, like Beeby, emphasized the complete sterility of the hybrid plants they had studied, Chapple (1948) found that though, in general, capsules are not formed, when they are, "an occasional unformed seed will be found". Chapple's use of the word "unformed" was unfortunate: no doubt what he meant was "poorly-developed".

Subsequent descriptions of *J.* × *surrejanus* have either overlooked or ignored Chapple's observations and most of them follow Timm & Clapham (1940) in emphasizing the complete absence of seed production (Richards 1962; Stace 1975). Nilsson & Snogerup (1972), on the other hand, state that, rarely, one or a few seeds are formed in some capsules, and their illustration of the hybrid shows a moderately well-developed capsule.

Our own interest in this hybrid arose from our independent observations that plants collected from a number of localities in north-western Wales, which appeared from their morphology to be this hybrid, occasionally produced plump, normal-looking seeds. Furthermore, the extreme variation found amongst the hybrid plants was much greater than one is led to expect from published descriptions. Consequently, in 1983 a more extended search was made for this hybrid to enable its morphological variability to be investigated more thoroughly, and sufficient material was gathered late in the year in order to estimate the frequency with which seeds occur and to test their viability. It was also possible to locate plants in two localities in Anglesey and Caernarvonshire where Zandee (1981) had previously reported hybrid material confirmed by him cytologically.

TABLE 1. COMPARATIVE CHARACTERS FOR *J.* × *SURREJANUS* AND ITS PARENT SPECIES**

	J. articulatus	*J. acutiflorus*	*J.* × *surrejanus*
Rhizome system	Subcaespitose or shortly creeping	Far creeping	Far creeping
Flowering stem	Decumbent, flexible	Erect, stiff	Intermediate
*Length of flowering stem, cm	35·8 (s.d. 15·4), 14–58	71·7 (s.d. 16·4), 27–110	68·5 (s.d. 22·0), 20–126
*Number of leaves per stem	3·7 (s.d. 1·2), 2–8	2·7 (s.d. 0·6), 2–4	3·8 (s.d. 0·8), 2–6
Appearance of leaves	Ribbed, dull, soft and curved	Smooth, shining, stiff and straight	Smooth, somewhat shining, moderately flexible and often curved
*Length of second leaf from stem apex, cm	8·8 (s.d. 3·4), 3·0–15·3	28·7 (s.d. 6·2), 18·0–41·2	14·0 (s.d. 4·7), 6·2–27·8
Flattening of leaves	Strongly compressed	Subterete	Subterete or somewhat compressed
Inflorescence branches	Generally few; ascending at a narrow angle to the vertical	Many; basal long, ascending almost vertically; shorter branches widely spreading	Variable in number; long branches ascending almost vertically; shorter branches widely spreading
Peduncles of flower heads	Long	Short	Variable; mostly intermediate
*Number of heads of flowers per inflorescence	18·2 (s.d. 11·9), 3–55	50·1 (s.d. 24·9), 11–102	24·9 (s.d. 15·9), 3–65
*Number of flowers per head	6·4 (s.d. 2·6), 2–15	8·3 (s.d. 3·3), 2–20	11·7 (s.d. 5·6), 2–34
*Length of perianth segments, mm	2·6 (s.d. 0·2), 2·3–3·3	2·1 (s.d. 0·2), 1·5–2·5	2·7 (s.d. 0·3), 2·0–3·4
Length of inner perianth segment relative to outer	Equal	Greater	Generally equal, occasionally slightly longer
Tips of outer perianth segments	Straight	Curved outwards	Often straight, sometimes slightly curved outwards
Length of ripe capsule relative to perianth	Longer (up to 3·5 mm) and protruding	Longer (up to 3·0 mm) and protruding	Very little longer and scarcely protruding
Colour of ripe capsule	Black and shining	Brown	Greenish-brown

* Figures given represent sample mean (standard deviation), range.

** Data for all characters are based on plants collected from populations in north-western Wales.

MATERIAL AND METHODS

Altogether, material was gathered from 22 plants of the hybrid from 15 separate localities in north-western Wales; material of the parent species was also collected from each locality when available. The hybrid was found in a variety of different habitats, including a range of lowland mire types which had generally been partially drained and where *J.* × *surrejanus* at times occurred in considerable abundance.

The search for seeds was made by opening undehisced capsules, and all the seeds obtained, regardless of their quality, were placed immediately on damp blotting-paper in Petri dishes.

At the same time a count was made of the number of flowers per head and data were later collected for culm stature, number of leaves per stem, length of the second leaf from the stem apex and number of heads per inflorescence. A sample of five or more perianth segments from dissected flowers was measured under the low power of the microscope, inner and outer segments being measured separately. Capsules were also measured when present. Similar morphological data were collected from material of the parent species for comparison.

Living material of one hybrid plant from Cors Geirch was brought into cultivation and actively-growing root-tips were used to obtain a somatic chromosome count. Root-tips were fixed in acetic alcohol and subsequently hydrolyzed in 0·1M HCl prior to being stained and squashed in aceto-orcein.

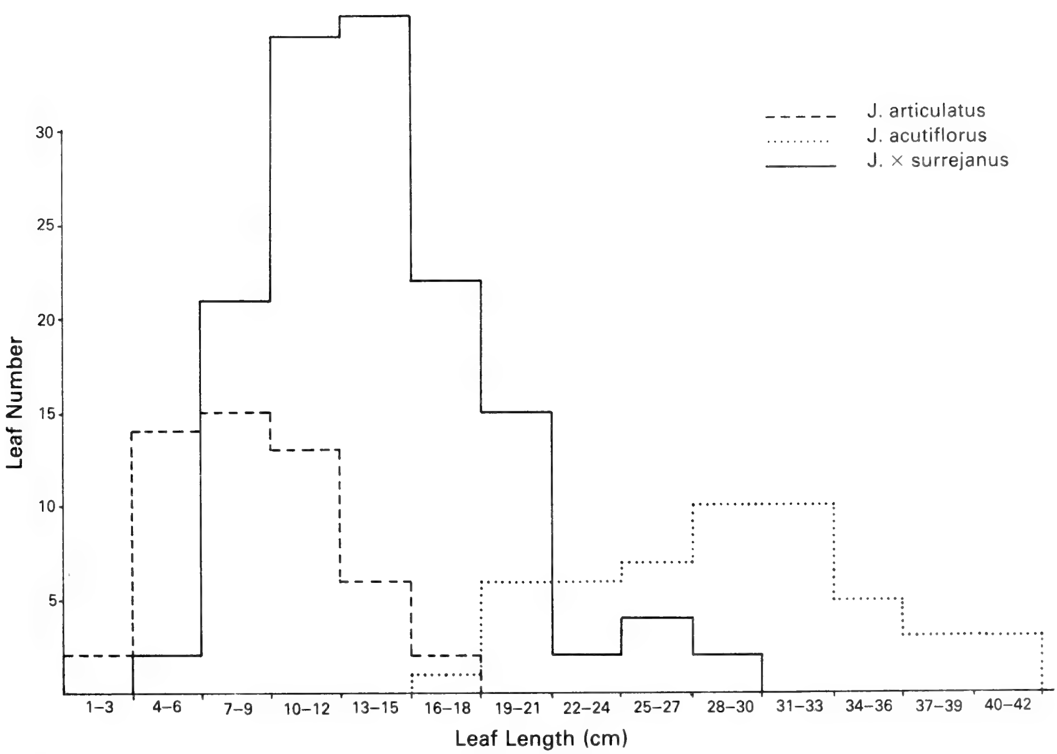

FIGURE1. Histograms of leaf lengths of *J.* × *surrejanus* and its parent species for samples from populations in north-western Wales. In all cases measurements were made on the second leaf from the stem apex.

RESULTS

MORPHOLOGY

Morphologically the hybrid shows a very wide range of variation in almost all characters; data for the hybrid and both parent species are summarized in Table 1. The mean stature (69 cm) is similar to that of *J. acutiflorus* (72 cm) but the range of variation (20–126 cm) is greater than in that species (27–110 cm). The flowering stems are stouter than those of *J. articulatus*, but are usually flexible and never as stiffly erect as those of *J. acutiflorus*. The habit of the hybrid plants is generally intermediate between that of the parents, most of those observed being partly decumbent and only rarely prostrate.

The leaves of the hybrid are mostly intermediate in appearance between those of the parents, often somewhat curved, smooth and shining and never as straight and stiff as those of *J. acutiflorus*, nor as dull and strongly compressed as those of *J. articulatus*. The number of leaves per stem varies from 2 to 6, compared with 2 to 4 in *J. acutiflorus* and 2 to 8 in *J. articulatus*. Although there is overlap with its parent species in leaf length (Fig. 1), the leaves of the hybrid tend to be intermediate (mean 14·0 cm) between the much shorter leaves of *J. articulatus* (mean 8·8 cm) and the much longer leaves of *J. acutiflorus* (mean 28·7 cm). These mean values agree remarkably closely with those given by Timm & Clapham (1940) for plants from the Oxford district: *J. articulatus*, 9·3 cm; *J.* × *surrejanus*, 13·8 cm; and *J. acutiflorus*, 28·0 cm.

The inflorescence in general resembles more closely that of *J. articulatus*, both in its longer (but more spreading) branches and in the number of heads per inflorescence (range 3–65). The number of flowers per head is often much greater (range 2–34) than that reported by Timm & Clapham (1940) (range 3–6), and the heads themselves are often enlarged by continuous flowering, so that there can be a larger number of flowers per head than in either *J. acutiflorus* or *J. articulatus* (Fig. 2). This was also remarked on by Timm & Clapham (1940) and by Nilsson & Snogerup (1972).

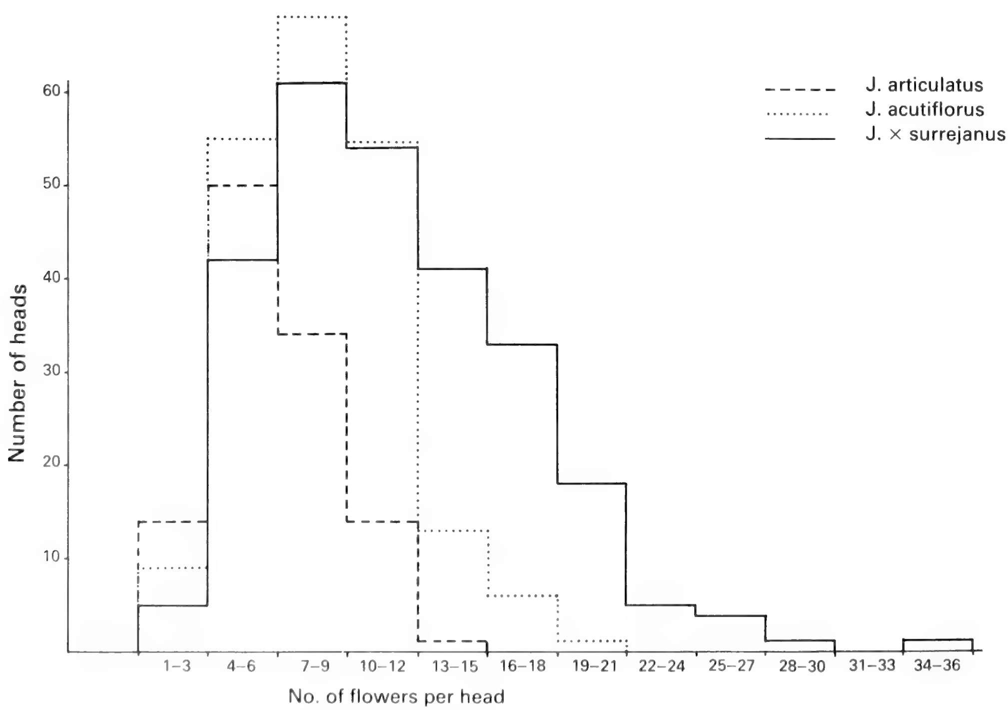

FIGURE 2. Histograms of number of flowers per head in inflorescences of *J.* × *surrejanus* and its parent species for samples from populations in north-western Wales.

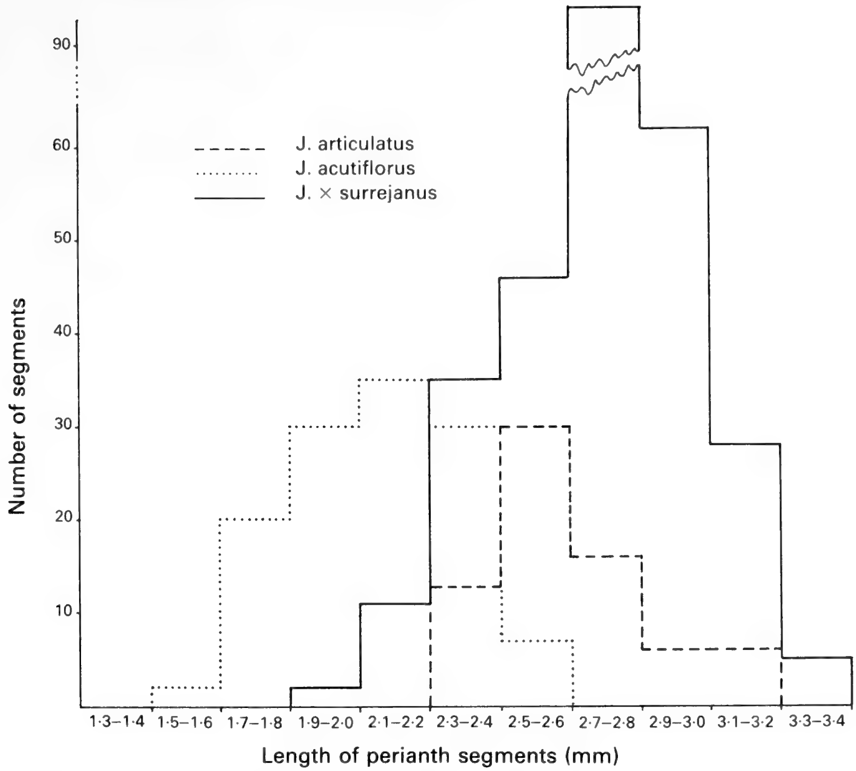

FIGURE 3. Histograms of perianth segment lengths of *J.* × *surrejanus* and its parent species for samples from populations in north-western Wales. Measurements of both inner and outer perianth segments are included.

A feature of the hybrid plants which becomes more noticeable later in the season (mid-October to November), and which can give some of them a striking and attractive appearance, is the ability to proliferate both from the nodes of the stem and from the axes of the flower heads. Such plants were also noticed by Timm & Clapham (1940) who were undoubtedly correct in suggesting that plantlets arising from proliferation constitute an effective method of vegetative reproduction.

Flower size in the hybrid and its parent species is very variable, as can be seen in Fig. 3. The mean length of perianth segments in different hybrid plants ranged from 2·2 mm – similar to that in many plants of *J. acutiflorus* – to 3·3 mm, which is larger than that in any of the plants of *J. articulatus* studied. The size of the flowers varies a good deal even among those of a single head, e.g. 2·4 mm–3·4 mm in the Plas Bog hybrid, and the mean for the aggregate of all samples of perianth segment length in the hybrid (2·7 mm) is greater than the mean in either *J. acutiflorus* (2·1 mm) or *J. articulatus* (2·6 mm). The inner perianth segments are longer than the outer in *J. acutiflorus*, whereas in the hybrid they are equal in length, or the inner may be very slightly longer.

The frequency with which capsules are developed in different plants of the hybrid varies from 20% to almost 100% of the flowers. The capsules are more or less intermediate in shape between those of the parents and their colour is greenish-brown in contrast to the shining black capsules of *J. articulatus* and the brown capsules of *J. acutiflorus*; they are also shorter in relation to the perianth so that only the beaks of the capsules protrude beyond the perianths at maturity. This is also true of capsules in which seeds have developed, and only rarely do these show a better development than the empty ones. It is possible that the capsules swell in response to pollination even though fertilization does not take place.

Timm & Clapham (1940) found that examination of pollen in aceto-carmine was not helpful in distinguishing the hybrid as about 80% of the tetrads appeared normal. Lambinon & Stace (1983), on the other hand, state that the pollen of the hybrid is largely sterile. The pollen of hybrid plants in north-western Wales was found to be highly variable in both quantity and quality. Anthers and pollen from freshly-gathered material of *J.* × *surrejanus* as well as its parent species were stained in lignin pink. In contrast to *J. acutiflorus* and *J. articulatus*, where abundant and evenly-formed pollen tetrads are produced, the anthers of many hybrid plants were either empty or contained only very few grains. In others there was a full complement of pollen, but closer examination showed that often a high proportion of the grains had malformed tetrads with one or more of the units either small and misshapen or completely lacking. Most anthers also contained some completely empty grains, and in a few instances a small supernumerary unit was observed amongst the other four parts of the tetrad. Only occasional plants had a relatively high proportion (up to c. 60%) of normal-looking pollen.

SEED PRODUCTION

Out of 22 plants of the hybrid examined only two failed to yield any seed at all. In the other 20 the proportion of flowers which produced seed varied from 0·3% to 20%. The quality of the seed varied from completely empty testae through thin, partly-developed seeds to some which were plump and normal-looking; these last were as large as the seeds of *J. articulatus* and occasionally larger (up to 0·75 mm long). The quality of the seed also varied from one flower to another on the same plant and even within the same capsule, when more than 1 seed was present. In the great majority of plants (16), seeds were found to occur singly within the capsules, only rarely were two or three found together and only in one plant were there more, as can be seen from Table 2, which also shows the number of flowers examined, the number of seeds found and the number of these which germinated.

TABLE 2. SEED PRODUCTION AND GERMINATION IN *J.* × *SURREJANUS*

Plant no.	Locality (v.c.)		No. flowers examined	No. seeds found	Max. no. seeds capsule^{-1}	No. seeds germinated
1	Cwm Nantcol	(48)	85	1	1	0
2	Bethesda	(49)	92	6	1	2
3	Cors Geirch	(49)	44	3	1	2
4	Hirdre Uchaf	(49)	10	2	2	0
5	Nant Ffrancon, 1	(49)	530	24	1	9
6	Nant Ffrancon, 2	(49)	380	36	1	7
7	Pant Glas, 1	(49)	84	28	8	3
8	Pant Glas, 2	(49)	59	3	1	0
9	Llyn Ystumllyn	(49)	85	0	—	—
10	Craig Wen, 1	(52)	63	0	—	—
11	Craig, Wen, 2	(52)	127	1	1	0
12	Gwenfro Isaf, 1	(52)	45	7	3	0
13	Gwenfro Isaf, 2	(52)	38	3	1	0
14	Llanbedrgoch	(52)	390	1	1	1
15	Llaneilian, 1	(52)	82	10	3	3
16	Llaneilian, 2	(52)	32	6	1	0
17	Malltraeth Marsh	(52)	51	1	1	0
18	Mynydd Bodafon	(52)	67	4	1	3
19	Newborough Warren, 1	(52)	88	1	1	1
20	Newborough Warren, 2	(52)	270	5	1	3
21	Plas Bog, 1	(52)	170	14	1	5
22	Plas Bog, 2	(52)	90	1	1	0
	TOTAL		2882	157		39

SEED GERMINATION

The first seed germinated five weeks after sowing; others germinated at intervals from 25th November 1983 to 12th April 1984. As soon as they had germinated the seedlings were placed on sterilized compost. In a few instances the seedlings failed to develop chlorophyll or showed some other abnormality, made no further growth and eventually died. Out of 39 seeds which germinated, eight have failed, but the other 31, from eleven separate plants, are growing (some of them quite vigorously) and it is worth noting that, of these, two are from the Cors Geirch plant whose identity was confirmed cytologically ($2n$ = 60).

DISCUSSION

Observations on the plants from different populations of *J.* × *surrejanus* have revealed that this hybrid exhibits considerable morphological variation in north-western Wales. Although there is generally a broad overlap with its parent species, the hybrid shows a degree of intermediacy in some characters, e.g. growth habit, mean number of leaves per stem, mean leaf length and inflorescence branch angles. In other respects, however, *J.* × *surrejanus* tends more closely to approach one or other of its parents, especially *J. articulatus*, which it resembles, for instance, in the inner and outer perianth segments of each flower being more or less equal in length and in the frequent occurrence of vegetative proliferation. This wide morphological overlap can result in considerable difficulties in the recognition of *J.* × *surrejanus* in the field. In our experience, identification can only be tentative until mature inflorescences of all three taxa are available for comparison in a particular locality. At that stage the ripe capsules of both *J. acutiflorus* and *J. articulatus* protrude well beyond the perianth segments whereas, when capsules are formed in the hybrid, they hardly exceed the perianths. The length of the perianth segments in at least some flowers is generally greater than in either of the parent species and, late in the year, when continued flowering has often taken place, the combination of large flowers with non- protruding or undeveloped capsules and large number of flowers per head gives the hybrid a particularly distinctive appearance, as may be seen from the silhouettes in Fig. 4.

The morphological variability of *J.* × *surrejanus* may be in part due to the range of environmental conditions in which it and its parent species grow. The plants included in this investigation came from a variety of lowland habitats, including damp depressions in fixed-dune grassland, partially drained valley mires and flood-plain alluvial marshes, amongst which there is a considerable range of soil conditions, water-table behaviour and vegetation structure. Although the majority of localities reported for *J.* × *surrejanus* are in the lowlands, there is a specimen of this hybrid in **UCNW** collected at c. 1200 feet [370 m] on Snowdon by S. M. Walters in 1950. The extreme variability of *J. articulatus* is well known, and some of the characteristics of different variants of this species are associated with certain ecological conditions (Clapham 1949), so that the morphology of hybrid progeny in a particular locality may be influenced by an interaction of environmental and genetical factors.

All the previously published descriptions of *J.* × *surrejanus* in the British literature emphasize the feature of complete seed-sterility for this hybrid. In marked contrast, many of the hybrid plants examined from populations in north-western Wales have been found to be partially fertile and produce germinable seed, albeit in usually very small quantity. Although there is no conclusive evidence that either backcrosses or F_2 hybrids have become established in the wild, the possibility that hybrid complexes might occur should be borne in mind in future population studies of these jointed rushes. It is also not inconceivable that some of the morphological variation of *J.* × *surrejanus* described here and elsewhere could be accounted for by the inclusion of individuals of subsequent generations, derived at least partly from F_1 plants. Nilsson & Snogerup (1972) have suggested that the plants referred to by Timm & Clapham (1940) as "large 80" might have resulted from backcrossing of *J.* × *surrejanus* to *J. articulatus*. These "large 80" plants had a mixture of characters of both *J. acutiflorus* and *J. articulatus*, but were seed-fertile with a chromosome number of $2n$ = 80, which led Timm & Clapham (1940) to postulate a number of other possibilities regarding their taxonomic status, and the situation clearly requires further cytological and experimental investigation.

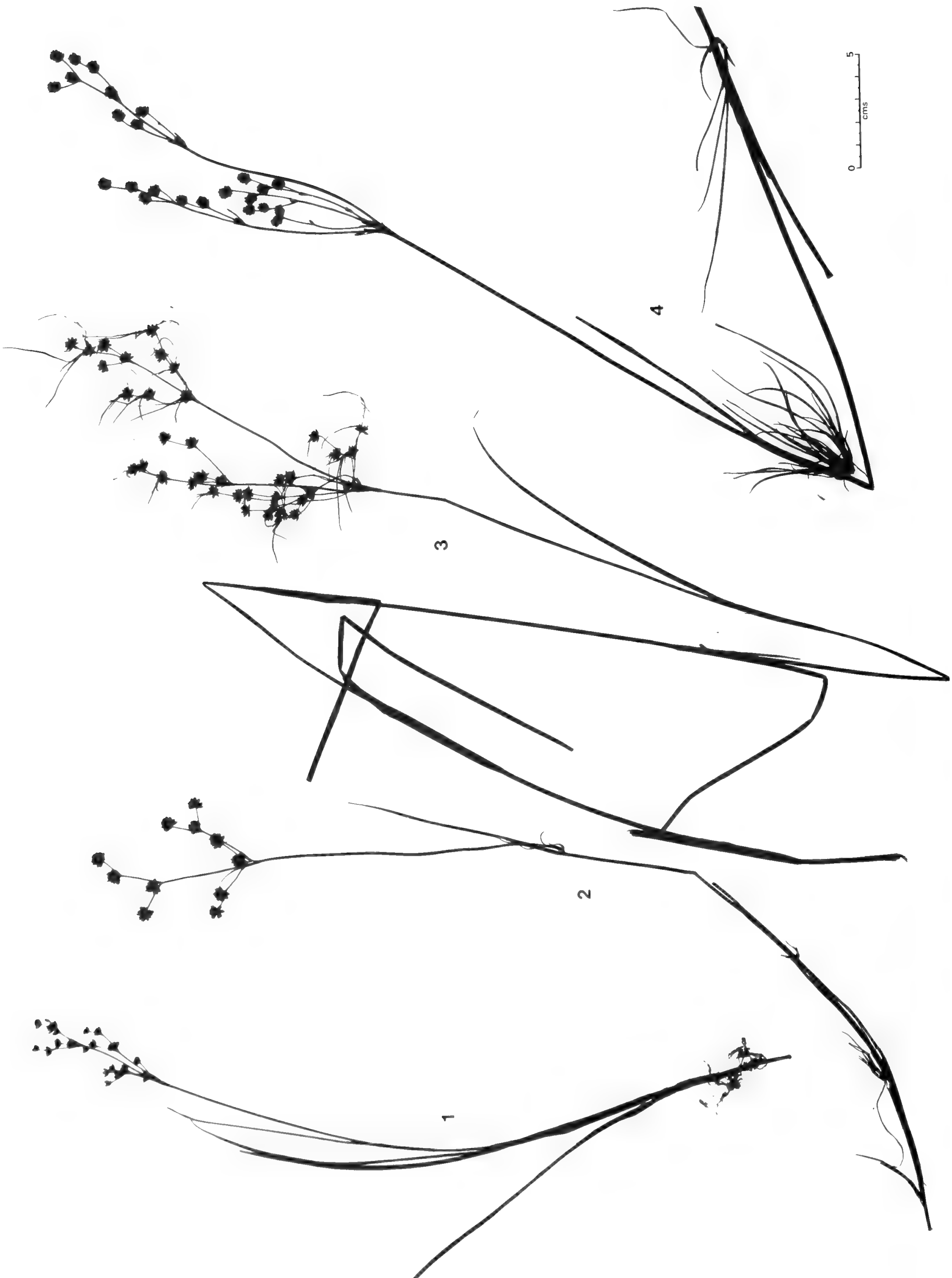

FIGURE 4. Silhouettes of flowering stems of *J.* × *surrejanus* from four localities in north-western Wales: 1. Newborough Warren, 2. Nant Ffrancon, 3. Cors Geirch, 4. Malltraeth Marsh.

ACKNOWLEDGMENTS

We would like to thank Dr N. Blackstock for preparing root-tip squashes, M. Hesketh for producing the silhouettes, Dr C. A. Stace for kindly examining some of our specimens and Dr M. Zandee for providing details of localities in north-western Wales. Our thanks are also due to the North Wales Naturalists' Trust and various other landowners for allowing us access to sites.

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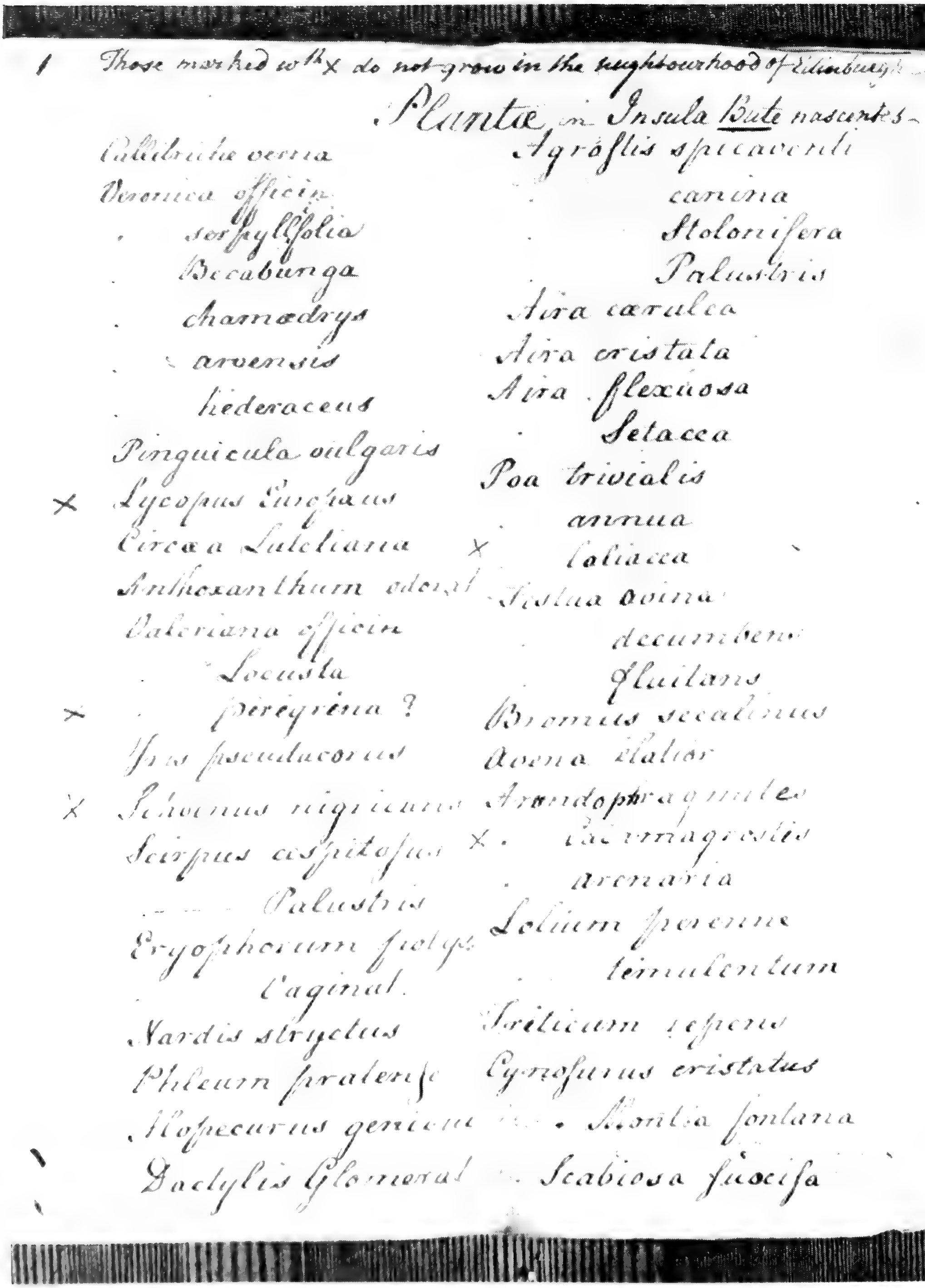

1 Those marked wth X do not grow in the neighbourhood of Edinburgh

Plantae in Insula Bute nascentes

Callitriche verna
Veronica officin
. serpyllifolia
. Beccabunga
. chamaedrys
. arvensis
. hederaceus
Pinguicula vulgaris
X Lycopus Europaeus
Circaea Lutetiana
Anthoxanthum odorat
Valeriana officin
. Locusta
X . peregrina ?
Iris pseudacorus
X Schoenus nigricans
Scirpus caespitosus
. Palustris
Eryophorum polyst
. vaginal.
Nardus strictus
Phleum pratense
Alopecurus genicul
Dactylis Glomerat

Agrostis spicaventi
. canina
. Stolonifera
. Palustris
Aira caerulea
Aira cristata
Aira flexuosa
. Setacea
Poa trivialis
. annua
X . Caliacea
Festuca ovina
. decumbens
. fluitans
Bromus secalinus
Avena Elatior
Arundo phragmites
X . Calamagrostis
. arenaria
Lolium perenne
. temulentum
Triticum repens
Cynosurus cristatus
. Montia fontana
. Scabiosa succisa

PLATE 1. Facsimile of page 1 of the list sent to Lord Bute. The last five pages of the list were written by Hope but the first four are in an unknown hand. It is perhaps significant that the only two puzzling names are on page 1. See discussions of *Veronica hederaceus* and *Valeriana pyrenaica*. Perhaps these names are the misunderstandings or carelessness of a transcriber and they remained uncorrected by Hope. See also the discussion of *Deschampsia setacea*.

Watsonia, **16**, 65–74 (1986)

James Robertson and the botany of Bute, 1768

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ABSTRACT

In 1768, during a visit of 18 days to the Isle of Bute, James Robertson recorded 445 plant species, comprising 357 angiosperms, one gymnosperm, 22 pteridophytes, 26 bryophytes, 16 lichens, 22 algae and one fungus. This long list demonstrates the high standard of botanical recording in mid-18th century Scotland. Excluding about 12 species that were certainly or probably misidentified, 35 species of vascular plant have no present records for the island. These include several geographical and/or ecologically noteworthy plants such as *Anacamptis pyramidalis*, *Apera spica-venti*, *Calamagrostis canescens*, *Coeloglossum viride*, *Cuscuta europaea*, *Deschampsia setacea*, *Polygonum viviparum* and *Vaccinium vitis-idaea*. In the manuscript, "[*Valeriana*] *peregrina*" may be a transcriber's error for *Veronica peregrina*.

INTRODUCTION

Employed at first as a gardener at the Royal Botanic Garden, Edinburgh, James Robertson became a highly assiduous, field-working associate of John Hope, Professor of Botany in the University of Edinburgh and King's Botanist (Fletcher & Brown 1970). According to Horn (1966) Robertson made the first recorded ascents of many Highland peaks. He was a skilled botanical artist (Lightfoot 1777, plate 28; Robertson 1768). After his Scottish journeys, in the 1770s he botanized in St Helena, Cape Province, India and China. Though Robertson has never been entirely forgotten (Fletcher 1959; Duncan 1980; Mackechnie 1958; Slack 1958; Slack & Dickson 1959), little has been written about him and he has sometimes been ignored or unmentioned by historians of botany.

Lodged in the library of the Marquess of Bute at Mount Stuart, Isle of Bute, are documents which reveal the efficiency and skilfulness of botanical recording in mid-18th century Scotland. They were written in 1768, four years before the visit by Lightfoot who published the first Flora of Scotland (1778 but dated 1777). There is a two-page letter, with the date 12th August 1768, which introduces a list of plants headed *Plantae in Insula Bute nascentes* (Plate 1). On eight pages of double columns and one page with a single column are 436 binomials mostly of vascular plants but also of bryophytes, lichens and algae. In addition there is a six-page document headed *Remarks made by James Robertson on the Island of Bute 1768.* These documents had been sent by John Hope to the third Earl of Bute, politician and devoted botanist. According to Hope's letter to Lord Bute, Robertson prepared a *Catalogue of Exotic Trees* and a *List of the four first classes of Animals* but these appear to have been lost.

The early history of botanical exploration in Scotland has been summarized by Fletcher (1959) and Balfour (1979) and is mentioned by Fletcher & Brown (1970); in none of these works is there any reference to the island of Bute. Botanical observations for Scottish islands prior to the mid-18th century are not unknown but are mostly insubstantial: Perring (1953) wrote concerning Martin Martin in the Hebrides, Sibbald (1710) concerning islands in the Firth of Forth and Raven (1950) concerning Ray on the Bass Rock. Wallace's list for Orkney (1700), however, includes over 250 names of vascular plants. The long list for Bute may well be the earliest extant compilation for a Scottish island made by professional Linnaean botanists. It appears to be the earliest thorough listing for any part of the west of Scotland.

Robertson travelled very widely in Scotland (Hope 1769; Robertson 1768). He botanized in the Highlands at least as early as 1766, and from 1767 to 1771 made very extensive tours each spring to autumn in the service of the Commissioners on the Forfeited Estates (Smith 1982). He kept journals of his tours (Anonymous 1966; Mitchell 1897). In 1768 he was instructed to examine "marine plants" (Foulis 1788) and was ". . . employed . . . in search of native plants on the sea coast and western isles of Scotland", according to an editorial note in Robertson (1768). Leaving Edinburgh on 10th May, apart from Bute, he visited Lanarkshire, Ayrshire, Wigtownshire, Arran, Mull and Skye. From the *Remarks* we know that Robertson sailed on 17th June 1768 to Kilchattan, Isle of Bute, from Brodick, Isle of Arran, where two years earlier he had been awaited as an adviser in ". . . Farming Including planting and wood Nursery" (Anonymous 1982). On 4th July, Robertson left Bute from the north end, crossed to Colintraive and made for Inverary (Foulis 1788). In September 1768 Robertson collected *Eriocaulon* on Skye (Hope 1769), where he stayed until 8th October.

Though Hope's British herbarium is lost, there is a notebook, kept in the Royal Botanic Garden (Anonymous 1907; Balfour 1900, 1901), which lists the specimens under the heading *A Catalogue of British Plants in Dr. Hope's Hortus Siccus, 1768*. Despite the heading, the *Catalogue* gives dates as late as the 1780s. The *Catalogue* mentions Bute 45 times, including nine references to vascular plants not in the list sent to Lord Bute. There is nothing to indicate that these additional records were made by anyone other than Robertson or at any time other than 1768. Therefore the 1768 recording of the Bute flora totals 445 species of all classes.

48 species not now known from Bute are in the list. About 12 are erroneous, several must be treated with caution, while others, for the most part distinctive species, are phytogeographically notable for the Clyde area or west of Scotland in general.

The nomenclature and taxonomic arrangement of the list is that of Hudson (1762) who adopted the Linnaean system. A copy of Hudson's book with Hope's book-plate and a few annotations is kept in the library of the Botany Department of the University of Glasgow, where there is also a second copy of *Hudson* signed by Hope on the title page. These may very well be the books used by Robertson and Hope in drawing up the list.

Diagonal crosses are placed before 31 names in the list (Plate 1). These indicate that the plants were not known to Hope as growing in the vicinity of Edinburgh. Six names in the list are followed by interrogation marks. Very brief comments follow four names. A pointing hand indicates "*Sisymbrium moniense*". These are all the annotations that Hope made to the list. Only two names of vascular plants in the list are puzzling.

It is clear from the *Catalogue* that Hope's herbarium included specimens collected by Robertson from Bute. In the absence of the specimens there can be no modern revision of the records.

Though many of the place names mentioned in the *Remarks* derive from the southern half of the island (Fig. 1), Robertson travelled widely on the island and may have visited Inchmarnock, the small island off the western coast. He saw and commented on the varied geology of the island which is bisected by the Highland boundary Fault and includes base-rich rocks (Hill 1979). He visited the southernmost parts of the island but it is not explicitly stated that he climbed the highest ground, Windy Hill, in the north, reaching 280 m. It would seem likely that such a thorough and energetic worker did so. However, he did not record the extensive stands of *Cladium mariscus* (L.) Pohl, a rarity in the Clyde area (Ballantyne 1897), from Bull Loch in the north.

The annotations to the list, the puzzling names, the erroneous and doubtful records, as well as the phytogeographically and ecologically notable species, are discussed below. The binomials are reproduced as written in the list except that the ligatures of a and e are separated and the long s as used in the 18th century is shortened (Tables 1 & 2). Modern synonyms of the Linnaean and Hudsonian binomials (Dandy in Stearn 1973) are given in brackets and follow Clapham, Tutin & Warburg (1981).

Though there have been several publications on the botany of Bute in recent years (Dickson 1981, 1983; Dickson & Boyd 1982; Kerr 1980; Mackechnie 1971; Marshall 1980), they are all short contributions. However, some 535 species of vascular plants have been recorded for the island since the last published listing by Ballantyne (1911). In making comparisons between the list and the modern flora I have used data compiled by the Biological Records Centre (1981), and recording from my field work in 1981 to 1985. Botanically minded members of the Buteshire Natural History Society have been helpful.

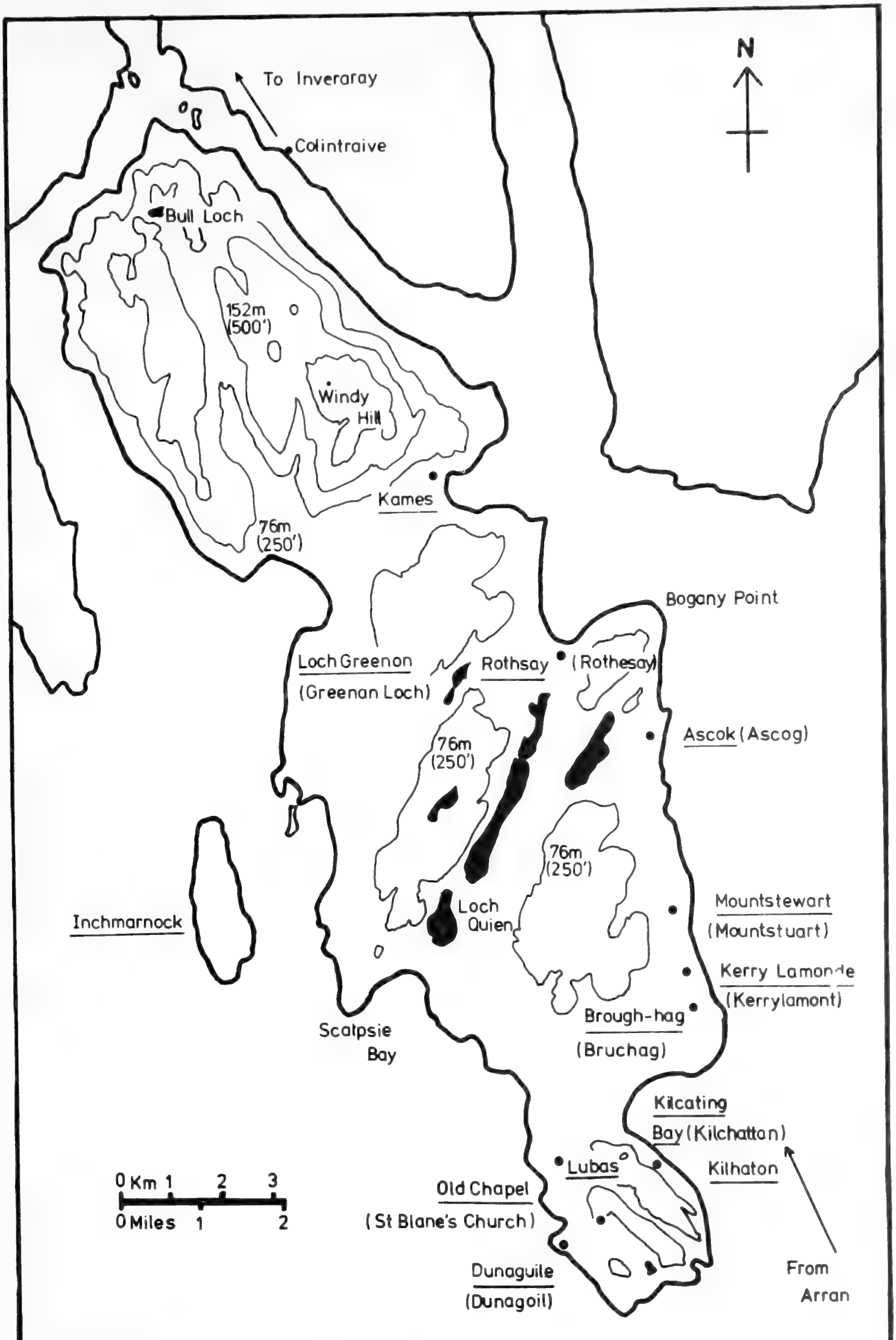

FIGURE 1. Map of the Isle of Bute. Place names underlined are those as written in the *Remarks*. Where different, modern spellings are shown in brackets. Freshwater lochs are shown in black.

TABLE 1. SPECIES NOW ABSENT FROM BUTE

Manuscript binomials are followed by their modern equivalents in brackets. A: No records since Robertson; B: No records since Ballantyne (1911); C: No records since Lee (1933); some of Lee's records may refer to the 19th century.

1. Weeds and garden escapes.	
Aethusa cynapium (*A. cynapium* L.) Fool's Parsley	A
Agrostema githago (*A. githago* L.) Corncockle	C
Agrostis spicaventi (*Apera spica-venti* (L.) Beauv.) Silky Apera	A
Anthemis nobilis (*Chamaemelum nobile* (L.)All.) Chamomile	A
Brassica campestris (*B. rapa* L. ssp. *sylvestris* (L.) Janchen) Wild Turnip	B
Bromus secalinus (*B. secalinus* L.) Rye Brome	A
Cheiranthus cheiri (*C. cheiri* L.) Wallflower	A
x*Cuscuta Europaea* (*C. europaea* L.) Large Dodder	A
x*Helleborus viridis* (*H. viridis* L.) Green Hellebore	A
[*Lolium*] *temulentum* (*L. temulentum* L.) Darnel	A
Scleranthus annuus (*S. annuus* L.) Knawel	A
[*Trifolium*] *agrarium* (**T. campestre* Schreb.) Hop Trefoil	B
2. Plants of unimproved pasture, wetlands, heaths, rough ground and the coast.	
Aira setacea (*Deschampsia setacea* (Huds.) Hack.) Bog Hair-grass	A
x[*Arundo*] *calamagrostis* (*Calamagrostis canescens* (Weber) Roth) Purple Smallreed	A
[*Carex*] *inflata* (†*C. vesicaria* L.) Bladder Sedge	A
Carex pilulifera (*C. pilulifera* L.) Pill-headed Sedge	B
[*Cerastium*] *Semidecandrum* (*C. semidecandrum* L.) Little Mouse-ear Chickweed	A
Filago germanica (*F. vulgaris* Lam.) Common Cudweed	A
Fumaria claviculata (*Corydalis claviculata* (L.) DC.) White Climbing Fumitory	B
[*Lycopodium*] *selago* (*Huperzia selago*) Fir Clubmoss	B
x*Ophioglossum vulgat.* (*O. vulgatum* L.) Adder's Tongue	A
[*Orchis*] *pyramidalis* (*Anacamptis pyramidalis* (L.) Rich.) Pyramidal Orchid	A
Orobus tuberosus (*Lathyrus montanus* Bernh.) Bitter Vetch	A
x*Poa loliacea* (*Desmazeria marina* (L.) Druce) Darnel Poa	A
x*Polygonum viviparum* (*P. viviparum* L.) Alpine Bistort	A
x[*Satyrium*] *albidum* (*Pseudorchis albida* (L.) Á. & O. Löve) Small White Orchid	B
x*Satyrium viride* (*Coeloglossum viride* (L.) Hartman) Frog Orchid	A
Saxifraga granulata (*S. granulata* L.) Meadow Saxifrage	A
x*Vaccinium vitis-idaea* (*V. vitis-idaea* L.) Cowberry	A
[*Vicia*] *lathyroides* (*V. lathyroides* L.) Spring Vetch	A
[*Vicia*] *sylvatica* (*V. sylvatica* L.) Wood Vetch	A
3. Aquatic plants	
Myriophyllum spicat (*M. spicatum* L.) Spiked Water-milfoil	A
[*Potamogeton*] *lucens* (*P. lucens* L.) Shining Pondweed	A
Sparganium natans (*S. minimum* Walbr.) Small Bur-reed	A
Zostera marina (*Z. marina* L.) Eel-grass	B
4. Certainly or probably misidentified plants. (Not recorded since Robertson's visit).	
x*Acrostichum ilvense* (**Woodsia alpina* (Bolton) S. F. Gray) Alpine Woodsia	
Bunium bulbocastanum (*B. bulbocastanum* L.) Great Pignut	
[*Carex*] *distans* (*C. distans* L.) Distant Sedge	
[*Carex*] *divisa* (*C. divisa* L.) Divided Sedge	
[*Equisetum*] *fluviatile* (**E. telmateia* Ehrh.) Great Horsetail	
Juncus acutus (*J. acutus* L.) Sharp Rush	
[*Potamogeton*] *compressum* (*P. compressus* L.) Grass-wrack Pondweed	
x*Potentilla argentea* (*P. argentea* L.) Hoary Cinquefoil	
x*Sedum sexangulare* (*S. sexangulare* L.) Insipid Stonecrop	
Sium latifolium (*S. latifolium* L.) Water Parsnip	
Thymus serpyllum (*T. serpyllum* L.) Thyme	
Ulmus campestris (*U. procera* Salisb.) English Elm	

*See Dandy in Stearn (1973). †See Jermy *et al.* 1982.

TABLE 2. ANNOTATIONS AND PUZZLING NAMES

Manuscript binomials are followed by their modern equivalents in brackets.

Cardamine hirsuta? (*C. flexuosa* With.) Wood Bitter-cress
[*Carex*] *vesicaria*? (†*C. rostrata* Stokes) Beaked Sedge
Draba verna? (*Erophila verna* (L.)) Spring Whitlow Grass
Populus nigra is it indigenous (*P. nigra* L.) Black Poplar
Prunus cerasus Huds. Geen=ang. (*P. cerasus* L.) Sour Cherry
Sambucus nigra is it indigen: (*S. nigra* L.) Elder
☞[*Sisymbrium*] *moniense* (*Rhychosinapis monensis* (L.) Dandy ex Clapham) Isle of Man Cabbage
x[*Valeriana*] *peregrina*? (*Veronica peregrina*?) American Speedwell?
Veronica hederaceus (*Veronica hederifolia*?) Ivy-leaved Speedwell?

*See Dandy in Stearn (1973). †See Jermy *et al.* (1982).

SPECIES NOW ABSENT FROM BUTE

More than 320 of the vascular plants recorded by Robertson are widespread, mostly abundant species still growing on the island. The following are also still present on Bute but are more or less rare in west-central Scotland and on the Clyde isles: *Baldellia ranunculoides*, *Bidens tripartita*, *Chaerophyllum temulentum*, *Conium maculatum*, *Glaucium flavum*, *Mertensia maritima*, *Osmunda regalis*, *Parietaria judaica* and *Saxifraga aizoides*. However, most interest centres on the species which have disappeared from Bute since the 18th century.

Of the 47 species listed in Table 1 the great majority have not been recorded since Robertson's visit. Weeds of arable farming constitute an important group (category 1). *Agrostemma* is an outstanding example of a bad weed rendered all but extinct in Britain by improved agricultural techniques. According to Hennedy (1865: 23) it was ". . . plentiful on Bute . . .". Lee's record (1933) may refer to the 19th century. The species of *Cuscuta* are all very rare in Scotland now and *C. europaea* is not considered native. The genus can hardly be in error but could the species have been *C. epilinum* Weihe? In the *Remarks* Robertson observed that the inhabitants ". . . sow oats, barley and some peas, *a good deal of flax*, and some hemp . . ." (my italics). Robertson's discovery of *Apera*, the only one for the island, may well be the first Scottish record.

The introduced and commonly ruderal *Chenopodium bonus-henricus*, recorded by Robertson and last seen in 1945, is another plant which has much declined, like the arable weeds. It may have escaped from cultivation, as probably had *Tanacetum*. Such as assessment applies with even greater force to *Helleborus*, *Chamaemelum* and *Cheiranthus*, all well-known garden plants and none native in Scotland. Robertson's specimen of *Cheiranthus* came from Rothesay where perhaps it grew on the walls of the ancient castle, but the species is not there now.

Category 2 (Table 1) covers a diversity of species including three plants often growing at altitudes far higher than those reached on Bute. However there need be no doubting Robertson's discoveries of *Huperzia selago*, *Polygonum viviparum* and *Vaccinium vitis-idaea* on grounds of his unfamiliarity with the species. In 1767 he had recorded *Polygonum viviparum* on hills in the Highlands and, for Ben Wyvis, he lists *Vaccinium myrtillus*, *V. uliginosum* and *V. vitis-idaea*. That Robertson knew his mountain plants is further made clear in a letter Hope wrote to Joseph Banks in February 1767. None of these three species is restricted to high altitudes. *Huperzia* was last reported for Bute by Ballantyne (1911). Still growing near sea-level in Kintyre (Cunningham & Kenneth 1979), it could well have inhabited moorland on Bute, especially in the north of the island where it may even linger. If it has disappeared, possibly grazing or fire was the cause (Page 1982). *Polygonum viviparum* has been recorded from the hills of northern Arran and also from three of the low hills of Knapdale (Cunningham & Kenneth 1979) which reach 550 m, 270 m higher than the Bute hills. However, the cliffy ground at the northern end of the island might harbour this species and also *Vaccinium vitis-idaea* which in Kintyre grows "on most hills from c. 500 ft. up" (Cunningham & Kenneth 1979). Fruitless hunts for these three species were made in 1982 and 1983 at the northern end of Bute, though some ground remains unsearched.

Not least because Robertson is known to have drawn four orchids, there are firm reasons for believing he had a good knowledge of these plants. His record of *Anacamptis* remains the only one for the Clyde area, though there is a recent record for south-western Kintyre (Cunningham & Graham 1979). The scarcity of this calcicolous orchid in Scotland was already realized by Lightfoot (1777) who stated "In dry pastures, but very rare, as near Kiloran in the island of Colonsa". Disturbed by holidaymakers and grazing animals, the very small areas of shell sand which remain on the western side of Bute and on Inchmarnock were searched in 1984 with negative results. Similarly, neither *Coeloglossum* nor *Pseudorchis* has been refound but they could still be discovered, both being inconspicuous, especially *Coeloglossum*. Both *Deschampsia setacea* and *Calamagrostis* need comment. If correct, this is the earliest Scottish record of *D. setacea* which, though scattered over Britain, is absent from all of southern Scotland and there are no Clyde area records (Perring & Walters 1976). Unknown now on Bute, the genus *Calamagrostis* is virtually absent from the Clyde area; the most likely species is *C. epigejos*, known from Kintyre (Cunningham & Kenneth 1979).

If in small stands in tall growing vegetation, another readily overlooked species is *Ophioglossum vulgatum*. However, if it has disappeared from Bute, this may be part of a marked decline over the last 300 years (Page 1982). Similarly, *Corydalis claviculata* may linger; perhaps referring to a record made 30 years earlier, Lee (1933) gave the species as growing at Scalpsie. That plants known to Robertson, but with no published records since his visit, can still be refound is shown by the discoveries of *Carex pallescens* and *C. pulicaris* in 1982 (Dickson & Boyd 1982) and, more surprisingly, of *Populus tremula* in 1984. However, aspen has only been encountered in the south-east of Inchmarnock where there is a small stand of fairly well-grown trees. On the mainland of Bute aspen may linger vegetatively as a small shrub in rocky ground or on a cliff as it does on Ailsa Craig and elsewhere round the Scottish coasts.

If only because of the state of knowledge of both taxonomy and topographical botany in the mid-18th century, it is inevitable that doubts arise about some of the entries comprising the long list of 380 vascular plants. However there are at least twelve species which deserve detailed consideration or can be freely accepted as mistakenly identified (Category 4, Table 1). On chorological and ecological grounds *Woodsia alpina* is an impossible record. Young *Cystopteris fragilis*, a species absent from the list but occurring now on Bute, may have been the source of error (Jermy *et al.* 1978). Robertson also found *Conopodium majus* (Gouan) Loret and not *Bunium bulbocastanum*; the two are superficially similar (Tutin 1980). *Carex distans* may possibly still occur on Bute. However, the then undescribed *C. binervis* Sm. could have been confused with *C. distans*, as claimed by Smith (1800) with reference to Lightfoot. *C. binervis* is such an abundant plant of moorland on Bute that Robertson must have seen it. *Carex divisa* is unlikely to be correct; the only two modern records of *C. divisa* in Scotland are possibly introductions (Jermy *et al.* 1982). Confusion with another species is the probable explanation but which species is far from clear.

In all likelihood Robertson saw the common plant now called *Equisetum fluviatile* L. and not *E. telmateia*. *E. fluviatile* is readily found at Greenan Loch, where Robertson botanized, as it is at other lakes on the island. Robertson's *Juncus acutus* was certainly *J. maritimus*. The only 20th century Scottish records for *Potamogeton compressus* were made in Angus where the species is now extinct (Ingram & Noltie 1980). The record for Bute, likely to be an error, was perhaps based on *P. obtusifolius* Mert. & Koch, well-known on the island now. *Potentilla argentea* is not a plant of the Clyde area at present. It is absent from the western seaboard of Scotland except for Dumfriesshire. A misidentification seems unlikely. The *Catalogue* uses both the names *Argentea* and *Argentina*, the second followed by "ad vias passim" (Anonymous 1907: 169). This clearly refers to *P. anserina* L., as it does in Hudson (1762). Perhaps there was a slip of the pen, the common *P. anserina* being intended. However, that being the case the "X" is hard to explain. Hope must have known *P. anserina* near Edinburgh.

The occurrence of *Sedum sexangulare* is extremely unlikely. It resembles *S. acre*, which Robertson found. Possibly the source of confusion may have been the then undescribed *Sedum anglicum* which Robertson must also have seen. It was described for the first time by Hudson (1778). *Sium latifolium* is a very rare Scottish plant with only two localities, both on the eastern coast. Perhaps Robertson saw *Berula erecta* (Huds.) Colville, not now known on Bute, or more likely, *Apium nodiflorum* (L.) Lag., known now on the island. Robertson would have seen *Thymus praecox* subsp. *arcticus* (Durand) Jalas and not *T. serpyllum*, in Britain only found in the Breckland of East Anglia.

Ulmus procera occurs only as a planted tree in Scotland and, because there had already been extensive tree planting on Bute long before 1708, Robertson may have seen that species. More likely, however, he saw the common, native *Ulmus glabra* Huds. In his 1767 journal Robertson uses only the name *U. procera*; it is highly improbable that he did not see *U. glabra* during his extensive travels.

ANNOTATIONS AND PUZZLING NAMES

The few species listed with qualifications and the two puzzling names are given in Table 2. The interrogation marks placed against *Cardamine hirsuta* and *Draba verna* are difficult to explain unless Robertson found only poor specimens. Difficulty in separating *Carex rostrata* from *C. vesicaria* may have made Robertson cautious and hence the interrogation mark.

The questioning of *Populus nigra*, if that is what Robertson saw, was well justified. Lightfoot (1777) was also doubtful. No modern botanist has claimed that Black Poplar is indigenous in Scotland. Perhaps also Robertson saw *Sambucus* only in the vicinity of buildings. Otherwise it is difficult to see why the native status is questioned. That such a thought occurred to him gains credance from the entry in Hope's *Calendarium Florae* (Anonymous 1907; 127) which states "Aug. 3. Sambucus niger. On a rock in a den, north of Aughtermughty, therefore a native".

"*Prunus cerasus* Huds. Geen. = ang." is a doubly noteworthy entry. It is the only one with a vernacular name, apart from one alga, and the only one referring to Hudson by name. The latter part I take to mean that the name in English is Gean, a name normally applied to *Prunus avium* (L.) L., as is done in the *Catalogue*. Probably *P. avium* was the plant seen by Robertson. The garden cherries, now seldom if ever seen wild in western Scotland, could well have been grown at Mount Stuart and seen by Robertson there. However, the list avowedly consists of indigenous plants.

Robertson, who had already found *Rhynchosinapis monensis* on the Ayrshire coast in 1766, found this British endemic on Bute where it was also seen by Lightfoot (1777: 353) ". . . about a mile to the south of Mount Stewart . . .". It is discussed by Ray (1724) and listed in both editions of Linnaeus (1754, 1759) but is omitted from Hudson (1762) as Hope's use of the hand symbol indicates.

The entry "X [*Valeriana*] *peregrina*?" is one of the most intriguing in the list. It is not a formal binomial used by any other author. Perhaps the interrogation mark implies that "*peregrina*" was being used informally, meaning literally foreign; the plant was unfamiliar and hence not considered indigenous. If so, this would be the only example of such a usage in the list. Moreover, elsewhere in the list the expression "is it indigenous" is written. What species of *Valeriana* could it have been? *Valeriana peregrina purpurea albave* of Bauhin, called *Valeriana cornucopiae* by Linnaeus, is the modern *Fedia cornucopiae* (L.) Gaertner. This is an annual, arable weed of the Mediterranean region. Not unlike a *Valerianella* but with conspicuous flowers, it has never been claimed as part of the British flora. If this is what was intended, why was the Linnaean binomial not used? Perhaps *Valeriana pyrenaica* should be given consideration. This robust species is locally well established in Scotland now and is known from Bute. Hope did not have a specimen but he knew the species (Anonymous 1907: 149). If the plant Robertson found was *V. pyrenaica*, why was the epithet *peregrina* used at all? Moreover why was the cross used? Could it be that *Veronica peregrina* was intended? The close proximity of *Valeriana* and *Veronica* in the list makes this a tempting conclusion (Plate 1). *Veronica peregrina* is very well established in the old walled garden at Kames (Dickson 1981). From the *Remarks* it seems likely that Robertson visited the castle there (Fig. 1), though the walled garden was not constructed until 1786 (Ross 1880). *Veronica peregrina* is not in the *Catalogue*. Therefore Hope and his associates may only have known it from the few lines in *Species Plantarum* and from the figure and description in Morison (1680) where it is called *Veronica annua alba polygonifolio*. That could account for both the cross and the interrogation mark. If "*Valeriana peregrina*" should be read as *Veronica peregrina* this was the first Scottish record and one of the first in the British Isles, long before those records made in Ireland (Bangerter 1964). Whatever the genus, the binomial is not in Hudson. Hope should have placed a pointing hand symbol against the entry, as was done in the list for *Rhynchosinapis monensis* and for 23 taxa in the *Catalogue*.

No 18th century author used the name *Veronica hederaceus*. Probably *V. hederifolia* L. was the species intended. That is the name used in the *Catalogue* (Anonymous 1907: 148). The species is now known to be markedly eastern in Scotland. It has not been recorded from Bute since Ballantyne (1911).

SPECIES MISSING FROM THE LIST

There are some noteworthy absentees from the list. By these are meant distinct species, recognized in the mid-18th century, which in all likelihood were just as common then as now. *Allium ursinum* L., *Drosera rotundifolia* L., *Hydrocotyle vulgaris* L., *Hypochaeris radicata* L. and *Rumex obtusifolius* L. are five which spring to mind. Though 30 taxa of grasses are listed, Robertson seemingly missed *Brachypodium sylvaticum* (Hudson) Beauv., *Deschampsia cespitosa* (L.) Beauv., *Phalaris arundinacea* L. and *Poa trivialis* L. All these species were in Hope's herbarium. However, *Festuca rubra*, though a Linnaean species and discussed by Hudson, is not in the *Catalogue* and so perhaps was not known to, or misunderstood by, Robertson and Hope and this omission can be explained. It is especially surprising that the common, conspicuous *Deschampsia cespitosa* is missing from the list. Could the rare *Deschampsia setacea*, discussed above, be a thoughtless transcriber's error for *D. cespitosa*, unchecked by Hope? See Plate 1. Another striking absentee is the sedge *Carex nigra* (L.) Reichard, which is conspicuous on Bute. Then known as *Carex cespitosa* L., this species can scarcely have escaped notice by Robertson who recorded no less than 17 sedges; the modern list totals only 23. However, none of the names used by Robertson can be applied to *C. nigra*. It is hard to account for some of these omissions except to say that nobody can find everything especially on a short visit or, perhaps, some species though recognized or even collected never found their way on to the list finally sent to Lord Bute.

CONCLUSION

In the letter, Hope praises the list as "numerous" considering the brevity of Robertson's visit. Even had Robertson stayed much longer on the island this is a claim with which one can readily agree. Robertson and Hope compiled a list of 380 species of vascular plants. It is clear that this represents a very substantial part of the flora that there was to find.

The disappearances of species recorded in 1768 and now extinct on Bute can for the most part be readily explained. The many changes in agricultural practices, such as the efficient cleaning of seeds, improvement in grassland management, drainage, fire and reclaiming of marginal land, may well have been the major agents. The misidentified species represent only a few percent of the total 380 vascular plants and are readily understandable with regard to the state of knowledge in the mid 18th century. The likely sources of these mistaken records are widespread species familiar in the west of Scotland.

The list in its length and detail and even in the annotations, sparse though they are, demonstrates the assiduousness, efficiency and perceptiveness of the partnership of Robertson and Hope. Like Hope, Robertson published very little and in consequence has suffered the undeserved fate of being little known to British field botanists.

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Short Notes

A RELIABLE METHOD FOR DISTINGUISHING BETWEEN *BETULA PENDULA* AND *B. PUBESCENS*

The difference in leaf shape between *B. pendula* Roth and *B. pubescens* Ehrh. is usually used to distinguish between these species. The difference normally cited is the shape of the leaf apex (acuminate in *B. pendula* but acute to subacute in *B. pubescens*). Many field botanists recognize the considerable degree of variation within these species (particularly in *B. pubescens*) and the consequent difficulty in identifying some specimens. Accordingly, there was felt to be a need to develop a method of identification which took this variability into account. Consequently, a quantitative method of expressing leaf-shape differences was developed following on the work of Nokes (1979).

Three characters are measured as follows:

1. Leaf tooth factor (LTF). A ruler is placed between the tips of the teeth at the ends of the third and fourth lateral nerves. The number of teeth projecting beyond this line is subtracted from the total number of teeth between the nerves (excluding the teeth at the nerve endings). This character was modified from the leaf tooth factor of Nokes (1979). In Fig. 1, LTF has a value of 3.
2. The distance, in millimetres, from the petiole to the first tooth on the leaf base (DFT), (Fig. 1).
3. Leaf tip width (LTW). The shortest width, in millimetres, of the leaf apex one quarter of the distance between the apex and the leaf base (Fig. 1).

To identify a tree, these three characters are measured on five short-shoot leaves from the lower

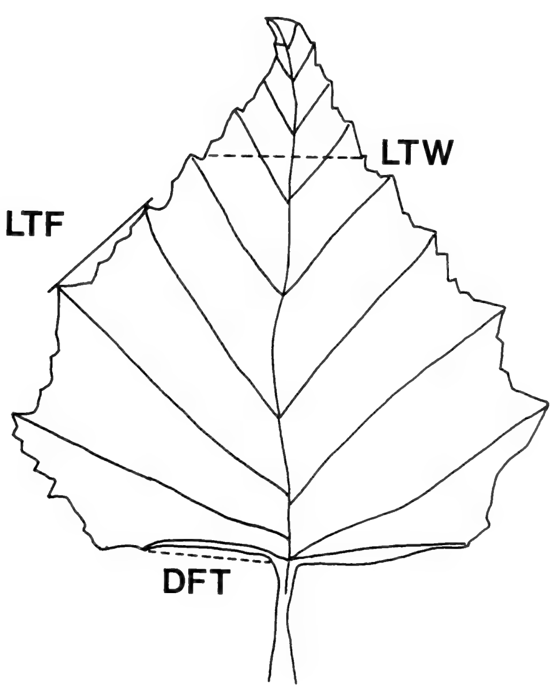

FIGURE 1. Measurement of leaf characters.

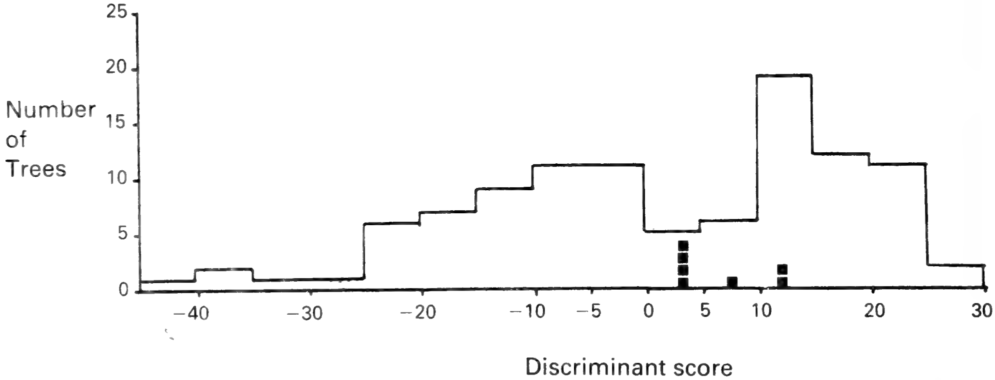

FIGURE 2. Frequency distribution of discriminant scores in the test sample of 104 trees. Plants with discriminant scores less than zero are *B. pubescens* (56 chromosomes) and those with scores greater than zero are *B. pendula* (28 chromosomes) with the exception of those plants marked with a (■) which are misclassified.

crown and averaged. The average for each character is multiplied by a constant and combined in the following discriminant function:

$$(12 \times \text{Average LTF}) + (2 \times \text{Average DFT}) - (2 \times \text{Average LTW}) - 23$$

If the solution is greater than zero, the tree is likely to be *B. pendula*; if it is less than zero, the tree is likely to be *B. pubescens*. This method gives a correct rate of classification of 93% (tested against chromosome number). This was based on a sample of 104 trees which were collected from 14 self-sown populations in England and Scotland. Most of these populations contained both species. Trees which have low values for the solution (between −5 and 5) are less likely to be correctly identified than those with higher numerical values. Of the sample tested, 15% had scores in this range, although only seven trees (7% of the sample) were incorrectly identified. In this sample, only *B. pubescens* trees were misclassified. Fig. 2 shows the distribution of discriminant scores for the test sample.

Another method has been developed which allows a higher degree of certainty of identification (97%). This requires considerably more calculation and will be dealt with in a later paper.

ACKNOWLEDGMENTS

The authors would like to thank Dr D. C. B. Nokes for the loan of material and for chromosome number data. We are grateful to Dr C. A. Stace for suggesting this note. The financial support of the Science and Engineering Research Council is gratefully acknowledged.

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MORE ABOUT SEA- AND LAKEBALLS

The publication, earlier this year, of my Presidential Address on 'Seaballs and Lakeballs' (Cannon 1985), in which I attempted to bring together information on naturally occurring plant fibre balls and related phenomena has, as is so often the case, brought to light further information of great interest that I should have liked to incorporate in the original paper. This short note may stimulate further interest in this unusual aspect of field botany.

Dr Elizabeth McClintock, at the Herbarium, University of California, Berkeley, has kindly drawn my attention to three further kinds of fibre balls (McClintock 1977). The first kind results from waste bark fibres from redwood timber extraction and processing on the northern California coast near Fort Bragg. Although some of the bark is itself used commercially, spillages occur into the ocean, where the fibres may become matted and twisted together to form balls which are subsequently cast up on the shore in great numbers. British botanists will probably be less familiar with the bark of the redwood (*Sequoia sempervirens* (Lamb.) Endl.) than with that of the related giant sequoia (*Sequoiadendron giganteum* (Lindley) Buchholz) from the Californian Sierras, which grows much better in our climate than the coastal redwood, and is widely planted in parks and large gardens. However, the general similarity of the very thick fibrous barks will enable readers to appreciate how seaballs from this markedly different source material can occur.

Dr McClintock also describes lakeballs formed from *Ruppia maritima* L. in Little Borax Lake, Lake County, California. Perhaps British botanists should bear in mind the possibility of finding fibre balls from this species, although the habitats of *Ruppia* known to me do not appear to be very conducive to ball formation. The *Ruppia* balls shown in the photograph in her paper look extraordinarily like *Posidonia* balls, but can, apparently, vary in size "from a baseball to a small watermelon". She also refers to a report by H. D. Thoreau as long ago as 1854 of lakeballs in Massachusetts. These were later stated by Ganong (1905) to be composed of fibres from *Eriocaulon* sp. He also refers to a lake in Idaho where species of *Ceratophyllum*, *Chara*, *Nitella*, *Zannichellia* and *Najas* are said to have been implicated in ball formation. Not many English or Welsh botanists have the opportunity to see *Eriocaulon*, but perhaps Scottish and Irish members will note this rather esoteric possibility.

Mr Peter Foss has kindly informed me of the occurrence of the 'mystery' Chater, Walters and Webb seaballs (now known to be composed of *Ammophila* root fibres) in additional Irish localities to that on the Dingle Peninsula where they were originally discovered (Cannon 1985). Perhaps they may yet be found in suitable British localities, where marram occurs abundantly in dunes above an extensive sandy beach which slopes gently into the sea in sheltered conditions? Mr Foss hopes to publish a short paper on the new Irish localities in due course.

On a recent holiday visit to the south of France, my wife and I visited the island of Port-Cros which, as one of the Isles d'Hyères, has been protected as the Parc National de Port-Cros. In addition to the land vegetation, the regulations also provide for an extensive marine reserve stretching out for a considerable distance from the shoreline. The reserve includes, in one of the more sheltered areas, a substantial bed of *Posidonia* and, to our intense amazement, in an otherwise unprepossessing beach cafe, there was offered for sale an excellent publication about the biology of *Posidonia* and its environment (Boudouresque & Meinesz 1982). It provides a complete account of the biology of the species and its ecology, rightly emphasizing the importance of the extensive *Posidonia* meadows as habitats for numerous marine animals, so contributing to the productivity of the Mediterranean and consequently of great relevance to long-term human economic interests. The need for conservation of *Posidonia* beds is rightly emphasized, as they are threatened today in many places, through pollution and the development of marinas and other coastal facilities.

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DACTYLORHIZA MAJALIS (REICHB.) P. F. HUNT & SUMMERHAYES SUBSP. *CAMBRENSIS* (R. H. ROBERTS) R. H. ROBERTS IN S.E. YORKSHIRE

On 29th June 1963, a population of marsh orchids with narrow leaves, some heavily marked, was found by the author on a marsh by the River Hull, near Wansford, 5 km S.E. of Driffield, GR 54/0.5, S.E. Yorks., v.c. 61. Two, representative, fresh specimens were sent to Kew and the late V. S. Summerhayes suggested that the plants might be *Dactylorhiza traunsteineri* (Saut.) Soó, but that he could not be certain without seeing the population and this he was never able to do.

In fact, the plants had features which were not correct for *D. traunsteineri*, notably the flowering spikes were not lax and the lowest leaf was not the narrowest. In November 1981, R. H. Roberts identified the taxon from colour transparencies, of both whole plants and close-ups of inflorescences, depicting two typical members of the population. Roberts (pers. comm.) stated that the plants undoubtedly belong to *D. majalis* (Reichb.) P. F. Hunt & Summerhayes subsp. *cambrensis* (R. H. Roberts) R. H. Roberts. In 1961, this subspecies was known only from coastal marshes on Anglesey, v.c. 52, and at Ynyslas in Cards., v.c. 46, but was found a year later in Caerns., v.c. 49, and in 1979 at two localities in Merioneth, v.c. 48.

Associated species at the S.E. Yorks. site were *Equisetum palustre*, *Caltha palustris*, *Ranunculus flammula*, *Cardamine pratensis*, *Lychnis flos-cuculi*, *Parnassia palustris*, *Mentha aquatica*, *Valeriana dioica*, *Succisa pratensis*, *Dactylorhiza fuchsii*, *D. incarnata* subsp. *incarnata*, *D. incarnata* subsp. *pulchella*, *Eleocharis palustris*, *E. uniglumis*, *Carex hostiana*, *C. viridula* subsp. *brachyrhyncha*, *C. panicea*, *C. flacca*, *C. diandra*, *C. disticha* and *C. dioica*.

A biometric study of the S.E. Yorks. population was carried out in 1964 and again in 1983 following the procedure adopted by Roberts (1961a). Table 1 gives sample data for the 1964 and 1983 S.E. Yorks. samples and those given by Roberts (1961b).

My data for the S.E. Yorks. *D. majalis* subsp. *cambrensis* population studied in 1964, including mean measurements for various structures (Table 1), match well those for the two populations first studied by Roberts (1961b) in Wales. Such minor differences as occur between the Yorkshire and Welsh populations may be the result of long isolation.

In 1979, Ettlinger & Roberts (1980) found populations of *D. majalis* subsp. *cambrensis* in two localities in Merioneth. The Merioneth populations, studied by Bateman & Denholm (1983) and on which their description of the taxon was based, differ from the S.E. Yorks. plants and those studied by Roberts (1961b) in a number of respects. Flower colour, shape of labella and labella markings, as depicted in photographs exhibited by Bateman & Denholm (1982) at the B.S.B.I. Exhibition Meeting in 1981, are markedly different from those of S.E. Yorks. plants, and R. H. Roberts (in litt.) confirmed that on the whole the flowers of the Merioneth plants are deep

TABLE 1. COMPARISON OF THE S.E. YORKS. *DACTYLORHIZA MAJALIS* SUBSP. *CAMBRENSIS* POPULATION WITH THOSE IN ANGLESEY AND CARDS.

Figures quoted are means with standard errors; N = sample size.

Character	S.E. Yorks. (1964) N = 30	S.E. Yorks. (1983) N = 10	Cards. N = 85[a]	Anglesey N = 92[b]
Height, mm	259±111	344±193	280±53	273±57
Total no. of leaves	6·2±0·2	6·8±0·3	6·6±0·1	6·8±0·1
No. of non-sheathing leaves	1·5±0·2	1·6±0·2	1·9±0·1	2·0±0·1
Leaf length, mm	129·0±4·7	128·0±7·2	124·0±2·4	123·0±2·6
Leaf width, mm	16·0±0·8	19·0±0·9	17·0±0·4	18·0±0·5
Leaf index (length/width)	8·3±0·3	6·8±0·3	7·3±0·2	6·8±0·2
Labellum length, mm	7·9±0·2	7·5±0·3	8·4±0·1	7·9±0·1
Labellum width, mm	9·5±0·2	9·5±0·4	10·4±0·1	10·6±0·1
Spur length, mm	7·3±0·2	7·0±0·3	7·9±0·1	8·7±0·1
Spur width, mm	2·3±0·1	2·1±0·1	3·3±0·1	3·2±0·1

a) N = 86 for labellum and spur dimensions.
b) N = 118 for labellum and spur dimensions.

magenta and have a diamond-shaped labellum with the labellum pattern concentrated in the central area. The typical flower colour of the S.E. Yorks. plants is identical with that of the original populations studied by Roberts. The leaf index of the Merioneth population sample is 5·3 (Bateman & Denholm 1983), within the range of that for *D. purpurella*, i.e. 3·1–6·1 (Roberts 1961a).

Conditions at the S.E. Yorks. site changed later in the 1960s, believed to be the result of nearby road construction possibly affecting the flow of spring water. *Menyanthes trifoliata*, previously confined to a corner of the marsh remote from the *D. majalis* subsp. *cambrensis* population, spread over the whole area; all *Dactylorhiza* populations were greatly reduced in numbers of plants, and flowering spikes of the *D. majalis* subsp. *cambrensis* colony became scarce and appeared spasmodically.

On 20th June 1982, only five plants of this taxon, only one having leaf markings, were found; these compared well with the 1964 population sample except for average longest leaf length. The data were as follows: average height 262 mm, average leaf number 6·2, average number of non-sheathing leaves 2·2, average longest leaf length 105 mm, maximum width of longest leaf 14 mm, average number of flowers in the spike 31·8.

In early July, 1983, ten plants were noted, eight with typical leaf markings and all the bracts and upper stem suffused with pigment. The sample data for this population are given in Table 1. Examination of the data, including notes on vegetative, inflorescence and floral features, revealed that this population resembled that studied in 1964 in most respects. The most marked differences were in the average height of the plants, the length of flowering spike (average 54 mm), and a tendency for a slightly wider leaf, although the leaf index of 6·8 is the same as that for the Anglesey colony.

Four of the plants examined in 1983 were in tall vegetation which may have affected height, but this cannot fully account for the greater average height. A possible explanation of these observed changes in the tetraploid *D. majalis* subsp. *cambrensis* population as revealed by the 1983 studies is that there has been past hybridization, most probably with the diploid *D.fuchsii*, and subsequent backcrossing from the F_1 to *D. majalis* subsp. *cambrensis* so that the population has become slightly introgressed. This theory is in line with the findings of Lord & Richards (1977) who demonstrated that triploid dactylorchid hybrids are by no means totally sterile, but may frequently cross among themselves, or backcross to the parents. A photograph of a plant, taken on the S.E. Yorks. site on 29th June 1963, has been examined by R. H. Roberts and tentatively identified as the hybrid *D. fuchsii* × *D. majalis* subsp. *cambrensis*, being similar to plants of this hybrid found in Wales. Also, a plant on the same site with intermediate characters and exceptional vigour, noted in 1982, was thought to be this hybrid and excluded from the population sample. The changed site conditions may have favoured the survival of hybrid derivatives.

ACKNOWLEDGMENT

I wish to thank Mr. R. H. Roberts for determining *Dactylorhiza majalis* subsp. *cambrensis* from photographs, for much valuable comment on my observations and for kindly reading the manuscript and making suggestions.

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THE REDISCOVERY OF CAREX MARITIMA GUNN. ON THE FAIRWAYS AT ST ANDREWS LINKS, FIFE

Carex maritima Gunn. is a rare sedge of sandy coasts in north-eastern Britain. During the present century it has been lost from many of its former strongholds, especially in eastern Scotland where, from E. Ross southwards, David (1982) listed the plant as still extant at only two of the 28 sites for which he had old records.

In Fife, v.c. 85, *C. maritima* used to occur at three localities: at Dumbarnie Links, 37/4.0, where it was recorded about a century ago (Howie 1884); at Tentsmuir, 37/4.2, where it was last seen in the late 1960s (M. Benstead pers. comm.) but is now almost certainly extinct; and at St Andrews Links, 37/5.1, where until summer 1984 it had not been recorded since 1911 (specimen in **STA**). *C. maritima* was first found on St Andrews Links by Maughan (specimen in **E**), and was recorded by Howie (1884) as occurring "on the old road that crossed the Swilkin Burn at St Andrews".

In 1984, the sedge was first discovered on 20th June in a damp hollow in the middle of the third fairway of the Jubilee Golf Course. This seemed a most unlikely habitat, yet since then I have crawled across all the St Andrews fairways and – to my utter astonishment – have now found it at 14 sites on the Jubilee Course, 14 on the New Course, six on the Old Course (including three on the eighteenth fairway!), and one on the putting green by the Swilkin Burn.

All the sites are on low-lying fairways that flood intermittently in winter (usually November – April), and despite much searching I failed to find the sedge on any of the uncut roughs. Some of the colonies are very large, with three sites on the Jubilee Course and five on the New Course each holding more than 1,000 plants. Three sites probably have over 100,000 plants each, and it occurs in these at extraordinarily high densities, with sample quadrats producing counts of 500–1,000 plants/m^2.

Apart from *Carex maritima*, the fairway 'slacks' are floristically of little interest, although *Isolepis setacea* occurs sparingly on the Jubilee Course and *Blysmus rufus* is co-dominant with *C. maritima* at two sites on the New Course. The sedge is generally found in damp grassland in which *Agrostis stolonifera*, *Carex flacca*, *Poa pratensis* and *Festuca rubra* are abundant, together with a few other 'wet slack' species such as *Juncus bufonius*, *Sagina procumbens*, *Glyceria declinata*, *Carex ovalis* and *Leontodon autumnalis*.

Perhaps the most surprising aspect of this plant's rediscovery has been to find it flourishing on some of the most intensively managed parts of the golf links. Management of the fairways includes regular cutting to keep the sward to a height of 2–3 cm, aeration of the turf by 'slitting' it in early winter, applications of organic fertilizers in spring, and (in some years) spraying with the broad-leaved weedkiller 2,4-D. This management may in fact favour *C. maritima*, as it keeps the turf fairly open and helps to restrain taller-growing species that might otherwise eliminate it from the sward. Indeed, on the fairways this sedge is probably at a competitive advantage – it can flower and set seed below the height of the cutting blades, is unaffected by 2,4-D, and may be encouraged to spread vegetatively by having its rhizomes repeatedly cut by the tractor-mounted 'slitter' used to aerate the turf. It also seems able to colonize divot holes and turf cuttings quickly, and can establish itself in reseeded areas before the grass sward becomes closed. It is surprising to note that some of the largest colonies (those on the first fairway of the New Course) are in turf that was layed as recently as 1974. The possibility cannot be ruled out that *C. maritima* was already in the turf at the time it was layed; however, I could find no evidence of the sedge in the area from which the turf was taken, and the habitat there does not appear at all suitable.

It is remarkable that *C. maritima* has remained undetected at St Andrews for so long. However, it must be admitted that this sedge is easily overlooked, and at St Andrews it is found in places that most field botanists would tend to leave well alone. Certainly its continued occurrence at this site is of considerable interest, not only because of its unusual habitat, but also because it appears to be flourishing here in greater quantity than at any of its other surviving British stations.

It would be most interesting to know whether *C. maritima* is still to be found on other Scottish sand dune systems where the wet slacks are now being managed as golfing fairways.

ACKNOWLEDGMENTS

I wish to thank the staff of the St Andrews Links Trust, and in particular W. Woods, for permission to visit the site and for information about how the fairways are managed. I am grateful to G. H. Ballantyne for details of old records, and P. K. Kinnear and H. J. Noltie for assistance with the field survey. I also thank Mrs D. Longley for her help in preparing this note.

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FILAGO PYRAMIDATA L. REFOUND IN WEST SUSSEX

Filago pyramidata, last recorded in W. Sussex, v.c. 13, in 1905, and known from only 14 localities in England since 1960 (Perring & Farrell 1983), was refound by H. W. M. in Halnaker Chalk-pit in 1983 and 1984.

In August 1983, one dry, shrivelled plant was found and at that time misidentified as *F. vulgaris* Lam., and in September of that year a further 15 seedlings were discovered. During July and August 1984, some 250 plants were found; E. C. Wallace and R. C. Stern suggested that these could be *F. pyramidata* L., a suggestion later confirmed by F. Rose and C. Jeffrey (B.S.B.I. Compositae Referee). By early September many hundreds of plants (possibly up to 1000) had been discovered in the chalk-pit. Of these, six were erect and approximately 17·5 cm tall, several were branched and semi-prostrate, and the remaining many hundreds, growing on bare, compacted chalk with the uncommon moss *Seligeria calcarea*, were only 1·25 cm or less, high. In the surrounding patches of very short, rabbit-grazed turf were several species of flowering plant including *Euphrasia nemoralis*, *Gentianella amarella*, *Centaurium erythraea* and *Agrostis stolonifera*, all very dwarfed and only 2·5 cm high or less, and also the moss *Homalothecium lutescens*.

In **BM** there is a specimen of *F. pyramidata* labelled "Halnaker Hill, 8 August 1891" that was collected by H. L. F. Guermonprez. This led us to the Guermonprez collection in the Portsmouth City Museums (**PMH**), in which a herbarium sheet is labelled "Halnaker Hill, Sussex (in chalk-pit)" and also "8 August 1891". H. L. F. Guermonprez specialized in painting the British flora, and among 2000 paintings in the collection at **PMH** is one of *F. pyramidata* painted in 1891 at Halnaker; the sharply five-angled capitula are clearly seen in the painting, just as they are in the growing plants at Halnaker – a key character which cannot be observed in pressed specimens. Guermonprez's working copy of *Flora of Sussex* (Arnold 1907) shows, in pencilled marginal notes, a drawing of the leaf shape (also diagnostic) and refers again to this locality.

Could the warm weather of 1983 possibly have influenced the number of seedlings which appeared in 1984? They may not be in such abundance every year, but their small size, inconspicuous habit and the fact that they flower only late in the season, leads us to suggest that the plants could well have been present but overlooked at this locality since 1891.

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CHROMOSOME NUMBERS OF IRISH PLANTS, 1.

This paper is the first of a projected series in which I shall provide chromosome counts, using material of known wild origin, of native Irish species. In practice this means that the series will cover virtually the entire Irish flora as very few previous counts of Irish material exist. Expediency dictates that the counts cannot be done following a systematic scheme and therefore several families will be covered by each contribution.

Because of the wide range of material to be surveyed it is not possible to provide more than an outline of the methods used. Generally, for meiotic counts flower buds are fixed, rapidly, in Carnoy's solution (6:1:3, absolute ethanol: glacial acetic acid: chloroform) or Dyer's modification of it (Dyer 1963). Mitotic counts are made from root material, pre-treated by placement in a cold room for 24–48 hours or more, or rarely pre-treated with 0·2% or 0·5% colchicine for either two or four hours. Roots are subsequently fixed, as above, and may then be hydrolyzed in 5N HCl, at room temperature, for up to one hour. Materials are stained using, preferably, the lacto-propionic orcein method of Dyer (1963) or, more rarely, aceto-carmine. Vouchers are deposited in **TCD**.

Crambe maritima L.	n = 30[1]	Co. Clare, v.c. H9: Portcowrugh, Inishmore, Aran Islands; sea-shore. 1972, *D. A. Webb*.
Euphorbia portlandica L.	n = 20	Co. Wicklow, v.c. H20: Mizen Head; sand-dunes. 1982, *P. Wyse Jackson*.
Hypericum androsaemum L.	n = 20	Co. Roscommon, v.c. H25: shore of Lough Ree; woodland. 1982, *P. Wyse Jackson*.
Hypericum canadense L.	n = 8[2]	W. Galway, v.c. H16: shore of Lough Mask; wet flush. 1981, *P. Wyse Jackson*.
Hypericum tetrapterum Fries	n = 8	W. Galway, v.c. H16: shore of Lough Mask; wet, peaty flush. 1981, *P. Wyse Jackson*.
Jasione montana L. var. *latifolia* Pugsley	n = 6	Co. Wexford, v.c. H12: Carnsore Point; stone wall. 1982, *J. A. N. Parnell*.
Ranunculus bulbosus L. var. *dunensis* Druce	n = 8	W. Galway, v.c. H16: Roundstone; grassland. 1982, *W. Bradley*.
Samolus valerandi L.	n = 13	Co. Wicklow, v.c. H20: Arklow; damp cliff-base. 1968, *D. A. Webb*.
Spergularia rupicola Lebel ex Le Jolis	n = c.18[3]	Co. Dublin, v.c. H21: Dun Laoghaire; harbour wall. 1969, *D. A. Webb*.
Thymus praecox Opiz subsp. *arcticus* (E. Durand) Jalas	n = 28[4]	Co. Clare, v.c. H9: Poulsallagh; dune grassland. 1979, *P. Wyse Jackson*.

Notes:
[1] The 2n = 30 cytodeme has not yet been detected in Ireland.
[2] Confirms the only previous count of 2n = 16 made on material from the same region by D. M. Moore (Webb & Halliday 1973).
[3] n = 19 was also recorded, but only from two cells; the extra chromosome may be an accessory.
[4] The only cytotype so far recorded in Ireland.

ACKNOWLEDGMENTS

I should like to thank Miss Y. Bannon for technical assistance and the staff of the Trinity College Botanic Gardens for keeping specimens of the species in cultivation.

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AN ADDITIONAL CRITERION FOR ASSESSING NATIVE STATUS

Eight criteria which can be used in assessing whether a species is a native member of the British flora have been discussed by Webb (1985). This note outlines a further criterion which has been of use in investigating this problem: the relationship of the species in question to oligophagous insects.

In only a few cases (so far) has entomological evidence been invoked in assessing native status. *Rhynchosinapis wrightii* is the host of two beetles of very restricted distribution. F. R. Elliston Wright used this as evidence for its native status before it was described as a species endemic to Lundy (Wright 1933; Lucas & Synge 1978).

Coombe (1956) showed that the presence of oligophagous insects on *Impatiens noli-tangere* can be used to distinguish sites where the species is probably native (in N. Wales and NW. England) from sites in southern England where it is a garden escape. *I. parviflora*, known to be introduced, is remarkably free from associated insects except where it grows in the vicinity of *I. noli-tangere* at sites where the latter is native.

Entomological evidence must be used with the same caution as Webb's criteria. Introduced species can attract oligophagous insects from related native species, as in the case of *Impatiens parviflora*. Other aliens are associated with insects that were presumably introduced with them. I have found that *Carpobrotus edulis* on the Lizard peninsula, W. Cornwall, frequently bears a scale insect which Mrs Linda Huddleston kindly identified as *Pulvinariella mesembryanthemi* (Vallot). This was originally described from France and only later discovered on native 'mesems' in South Africa. Similarly the weevil *Stenopelmus rufinasus* Gyll. is associated with the introduced fern *Azolla filiculoides* in Britain (Janson 1921; Flint 1979). It may be significant that both *Azolla* and *Carpobrotus* were probably introduced as living plants rather than as seed or spores.

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THE DISTRIBUTION OF *SORBUS LANCASTRIENSIS* E. F. WARBURG

Warburg (1957) published the description of a new species of whitebeam, *Sorbus lancastriensis*, from Humphrey Head, Westmorland, v.c. 69 (now Furness, v.c. 69b) and gave its distribution as "apparently restricted to several places on Carboniferous Limestone round Morecambe Bay in

Lancashire and Westmorland". Between 1982 and 1984 much of the limestone in this area was visited by the authors, and this note details the locations and approximate sizes of all the populations seen of this rare, endemic taxon.

Sorbus lancastriensis is often confused with two other species of *Sorbus* which also occur in north-western England, and with which it frequently grows: *S. aria* (L.) Crantz and *S. rupicola* (Syme) Hedlund. There are three reasons for this confusion. Firstly, it is essential to examine the correct leaves. Ideally, the three broadest leaves of a rosette from the short, lateral spurs of branches should be compared, as these are the most constant and typical for each species. Shade leaves, or leaves from the present year's growth, should be avoided as these are highly variable. Secondly, *S. aria* is very variable in leaf shape and size, and two specimens growing together may be superficially quite different, prompting identification of two taxa. Thirdly, the characters used in the key by Warburg (1952) to distinguish *S. lancastriensis* from *S. rupicola* are poor. The fruit and leaf toothing characters are useless, and there is too much overlap in the leaf venation character to allow diagnosis on its own. The more recent key by Game (1981) is much better and includes all the species of *Sorbus* in v.cc. 66–70. The species are distinguished here according to the following key, which is based on material of all three species from north-western England. A combination of characters must be used. *Sorbus lancastriensis* is very close to *S. rupicola* and the relationship between the taxa requires clarification.

1. Leaves ovate, rhombic to elliptic, rarely obovate, the base truncate to broadly cuneate (angle with central vein 45° or more), rarely cordate, toothed nearly to base, with (10·5)11 or more pairs of veins. Fruit length greater than or equal to width .... *S. aria*
1. Leaves obovate, oblanceolate or oblong, cuneate at base (angle with central vein less than or equal to 42(47)°), ± entire in lowest quarter, with 10(11) or fewer pairs of veins. Fruit width greater than or equal to length 2
2. Leaves erect, (1·7) 1·8–2·5 times as long as wide, with (5)6–9(10) pairs of veins .... *S. rupicola*
2. Leaves spreading, (1·3)1·4–1·75(1·9) times as long as wide, with (6·5)8–10(11) pairs of veins .... *S. lancastriensis*

Sorbus lancastriensis is very characteristic of the open limestone screes, rocks, crags, scars and cliffs within 30 km of Morecambe Bay, usually in small populations. It reaches the northern and southern limits of the local outcropping limestone at Cunswick Scar and Warton Crag respectively. The only locality not on limestone is at Roughholme Point where it occurs on a conglomerate drumlin. It grows from sea-level at Arnside to about 180 m at Cunswick Scar. It prefers open scrub and may persist in developing woodland but does not tolerate shade. It flowers and fruits freely in most localities and regenerates readily in the absence of grazing. The localities are listed below; full lists detailing 6-figure grid references are held by the Biological Records Centre, the vice-county recorders, the Nature Conservancy Council (N.W. Region) and the local Naturalists' Trusts. The names of localities used are those from the Ordnance Survey 1:10,000 series or 1:25,000 'Pathfinder' series.

West Lancashire, v.c. 60 (all 34/4.7):

Eaves Wood. Two sites: Castlebarrow (above Elmslack), around the pepperpot and in the woods below, c. 20 shrubs, the colony extending into Middlebarrow Plain (v.c. 69); and National Trust Nature Trail, c. 15 shrubs mixed with *S. aria*, extending down to Waterslack.

Jenny Brown's Point. A largely inaccessible population on Jack Scout sea-cliffs, mixed with *S. rupicola*, about 30 plants in total.

Scout Wood. Five or six shrubs on the scarp edge in woodland.

Silverdale Cove. Sea-cliffs to north and south of the Cove, c. 50 plants.

Warton Crag. Four sites: Beacon Breast, 10–15 shrubs; above Scar Close, five shrubs; Three Brothers Allotment, one shrub on limestone pavement with three *S. aria* plants; south of Crag Foot, nine plants on rocky outcrop above the road, with *S. rupicola*.

Westmorland, v.c. 69:

Arnside (34/4.7). Generally distributed around Arnside, Arnside Knott and Far Arnside, usually in small populations and frequently with *S. aria*. There are some populations along the Kent Estuary (Arnside–Grubbins Wood) which have some puzzling plants intermediate with *S. rupicola*, and it is not always possible to name an individual specimen. Arnside Knott, at least five shrubs; Copridding Heath, at least three shrubs; Arnside Park, a few trees scattered in woodland; Far Arnside, one plant in hedge by road, and then round the coast on cliffs to Arnside, c. 200 plants, with occasional *S. rupicola*.

Meathop (34/4.7). In the quarry and on sea-cliffs at the mouth of the River Winster, about ten shrubs mixed with *S. aria*.

Middlebarrow Wood (34/4.7). Limestone Pavement at the top of the wood.

Brigsteer (34/4.8). Three places: Burnbarrow Scar, many shrubs along the cliff edge; Crag Millot, about 15 shrubs in pioneer scrub; Windy Howe, one plant on roadside.

Scout Scar (34/4.8). Abundant (probably in excess of 200 plants) along the edge of the cliff with scattered shrubs in the woods and on the scree below.

Whitbarrow Scar (34/4.8). Locally abundant on cliffs from Raven's Lodge clockwise around the scar to Broad Oak, with occasional plants in the wood below. Probably in excess of 1000 plants, the largest population.

Yewbarrow (34/4.8) (A. Game). Abundant in open woodland with smaller shrubs on cliff and screes, probably 100–200 plants.

Cunswick Scar (34/4.9). Abundant along the open middle section of the scar, with one plant of *S. aria*.

Furness, v.c. 69b:

Humphrey Head (34/3.7). Abundant along the sea-cliffs and scar on the west side, over 200 shrubs mixed with a much smaller number of *S. rupicola* plants. One shrub also found at Roughholme Point.

Old Park Wood (34/3.7). On cliffs on west side, c.25 plants.

Reake Hill, Leven Estuary (34/3.7). 15–20 small trees on western side of hill.

Roudsea Wood N.N.R. (34/3.8). 1 large shrub in old quarry (N.C.C. and others).

There are also records in Ratcliffe (1977) which need verification or correction. The record for Gait Barrows N.N.R. (v.c. 60) is probably an error for *S. aria*. The record for Hutton Roof Crags and Farleton Knott (v.c. 69) has not been refound. The record of *S. rupicola* for Scout and Cunswick Scars, where the species has been searched for carefully without success, is probably an error for *S. lancastriensis*. There is also a National Trust record for Brigsteer Park (v.c. 69) which has not been refound.

The authors would be pleased to hear of any further localities. Other sites in which the plant should be looked for are about Grange, and the limestone on the west side of the Leven Estuary.

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The authors wish to thank Mr D. Earl and Mr & Mrs L. Livermore for their excellent company in the field and with whom many of the localities were found or verified.

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FURTHER DISCOVERIES OF *HIERACIUM BACKHOUSEI* F. J. HANB.

Hieracium backhousei F. J. Hanb., which is included in section *Alpina*, is one of the rarest British hawkweeds, and is endemic to Scotland. It was discovered by James Backhouse Jnr in 1886 at Dubh Loch, near Braemar, S. Aberdeen, v.c. 92, where a small population still occurs. No definite further localities had been reported until I found a small number of plants in 1976 on Derry Cairngorm, in Glen Derry, S. Aberdeen, which were subsequently confirmed as this species, and later in greater numbers locally in two places in Glen South Esk, Angus, v.c. 90, in 1981. Solitary plants, which also should possibly be referred to this species, were noted by me in Coire Etchachan and near Loch Etchachan in S. Aberdeen, and at the head of Glen Fee, Angus.

All the old records for *H. backhousei*, except for the Dubh Loch records, but including the one from Glen Derry (Linton 1905; Pugsley 1948), appear to refer to *H. memorabile* (Sell & West 1967, 1968).

At Dubh Loch, the population occurs in crevices and in pockets of coarse-grained granite by small waterfalls, very close to the running water. This habitat is matched exactly in both Glen Derry and in Glen South Esk, where the populations occur on slab rock or large boulders of granite, on islands or projections into the stream, again in the vicinity of small waterfalls. In Glen South Esk and at Dubh Loch the species is accompanied by another hawkweed from section *Alpina*, *H. calenduliflorum* Backh. Additionally, *H. hanburyi* Pugsl. and occasionally *H. atraticeps* (Pugsl.) P. D. Sell & C. West and *H. pseudocurvatum* auct. occur nearby. In the localities described, all of these hawkweeds generally occur somewhat further away from the running water than *H. backhousei*. It has also been noted that some of the pockets of rock where *H. backhousei* grows remain temporarily filled with water after heavy rain; and it would seem that the species requires more moisture around the roots than other species in section *Alpina*, as it does not stray onto adjacent ground further away from water, although the surface rock is normally dry as is the case with all species in section *Alpina*. In cultivation, however, it is surprisingly one of the easiest species to grow and it withstands summer drought conditions as well as other species in section *Alpina*.

H. backhousei is distinguished by its large capitulum, often single, from 30 mm to over 50 mm in diameter, or occasionally with two or more heads. The basal leaves are very rigid, coriaceous, drab, non-glossy green, being mainly elliptical and irregularly serrate-dentate with narrow-acute teeth. The lowest cauline leaf is often very similar to the innermost basal leaf, with a few narrow teeth which are frequently spinulose, and has some stellate hairs on the lower surface. The majority of leaf surfaces, except at the margins, have very few or no simple, eglandular hairs present. The involucre is often robust with broadish bracts (1·0–1·6 mm) which are abruptly acute to sub-acute, with only few obvious, very short, glandular hairs. The ligules are a bright, lightish yellow, with several very short simple eglandular hairs at the apices, and very few to several on the backs, and have yellowish styles.

The number of plants in Glen South Esk greatly exceeds the number at Dubh Loch; the former site, in v.c. 90, is therefore now the main station known for the species. It is surprising that *H. backhousei* has not been noted in Angus previously, although it might have been confused with *H. tenuifrons* P. D. Sell & C. West, and could occur in the described habitat elsewhere in the eastern Highlands. Specimens have been placed in **CGE** and in **herb. D.J.T.**

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I should like to thank Mr P. D. Sell for advice on preparation of this manuscript and confirmation of the identities of specimens.

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Book Reviews

The pollen loads of the Honeybee. A guide to their identification by colour and form. Dorothy Hodges. Pp. 51 & 14, with 10 colour plates, 30 black & white plates and 7 text figures. International Bee Research Association, London. 1984. Price £26.50 (ISBN 0–86098–140–1).

This is the second facsimile edition of a remarkable book that was first published in 1952 and was designed to provide a practical manual for the identification of pollen loads gathered by honey bees. As the authoress explains, the colour of a pollen load is indicative of the kind of plant from which the pollen originated. The strength of the book lies in the colour charts showing the colour of pollen loads collected from 120 different plant species. For most species three different pollen loads are illustrated, so that the natural colour variations, greater in some species than others, are indicated. The colour charts are arranged in six full-page plates in the order of flowering, to assist in the identification of pollen loads during the different seasons of the year. A further five plates of colour paintings show the processes by which bees collect and pack pollen loads and the colours of artificially produced pollen loads. There are also 30 pages of line drawings depicting the pollen grains of the most important sources of food for honeybees as seen in the light microscope. These drawings are reminiscent of those in the classic textbook on pollen by Wodehouse (1935). This is largely because they depict intact pollen grains which have not been subjected to the treatment with strong acids prevalent in palynological laboratories. As such they may serve as a practical means of identifying some of the more distinctive types of pollen with a relatively modest microscope.

The book has been revised to include a chapter, previously published elsewhere, on the methods of melissopalynology. This is undoubtedly a useful addition for those wishing to pursue the subject in a practical way but would have been better placed after the plates, since the stark style contrasts dramatically with the much more readable text of the book itself. A more useful revision would have been to have updated the literature references given. The classic textbooks concerned with the identification of pollen are mentioned, but most have passed through several editions more recent than those listed. Perhaps, more importantly, several new books could then have been included which provide keys and illustrations for identification. Recent works by Moore & Webb (1978) and Sawyer (1981), for example, contain keys and micrographs and are both modestly priced.

It may be hoped that such information will be included in a future edition, since there will be a continuing, and perhaps even a growing, demand for this unique book from bee keepers, pollination biologists and palynologists.

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The Longman illustrated dictionary of botany. A. Sugden. Pp. 192, with 300 coloured diagrams. Longman & York Press, Harlow, Essex & Beirut. 1984. Price £3.95 (ISBN 0–582–55696–1).

This reference book intended for amateur botanists and students of botany stands up to the publishers' claim that it defines clearly and simply both terminology and concepts used in the study of plant life and plant sciences. More than 1200 definitions are written in non-technical language and illustrated by 300 diagrams, most of which are in good colour with a few in black & white. It does not have the alphabetical arrangement customarily associated with dictionaries; but once the system is grasped in which the words are grouped in related topics as used in study courses, a comprehensive (alphabetical) index then leads to the section required.

There is a wide coverage of subjects relating to plants, some 23 headings including: flower biology and anatomy, development from seed or spore to mature plant, evolution and spread of a species and adaptation to habitat, habitat definitions, basic chemistry of plants, and a review of the plant kingdom. Appendix one is 'Understanding botanical words' and Appendix two is 'SI Units'.

The suggestion for the B.S.B.I. to review this book came from an amateur member, who recommended it; a Museum assistant scientific officer, taking Botany 'O' Level, evaluated the Dictionary as being useful for his studies; a senior taxonomist, checking for accuracy, reported this good in general, but found that the definitions of cyme and raceme do not distinguish between the position of the oldest flower, which makes the inflorescence determinate (cyme) or indeterminate (raceme); also the term strophiole is not included (although the page on seed structure does include definitions of hilum, micropyle and raphe). However these test words are possibly severe, as in general this clear, compact and handy reference book will doubtless be very useful for those for whom it is mainly intended: amateurs, sixth formers and first year undergraduate students.

M. Briggs

Leaves. G. T. Prance & K. Sandved. Pp xii + 244, with 310 colour photographs and 46 black & white illustrations. Thames & Hudson, London. 1985. Price £22.50 (ISBN 0–500–54104–3).

This lavish book is the result of co-operation between representatives of two famous botanical institutions in America: the text, accurate, as would be expected, is by G. T. Prance, Senior Vice-President for Science at the New York Botanic Garden; the spectacular photographs are by Kjell Sandved, of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. It is an 'eye-opener book' – exploring leaf form and function from a world-wide selection and from many angles, including shape, arrangement and colour – with much information that will be new to general readers, and with stunning photographs to illustrate the sheer beauty and diversity of leaves. There are sections on leaf margins, venation, hairs, prickles and poisons; dramatic sections on modified leaves, leaves as propagules, on carnivorous and on succulent leaves; also on those which carry spores, those patterned by leaf-miners and other predators, or those on and in which insects are sheltered; on leaves useful to man; and finally on fossil leaves. The last chapter gives brief advice on leaf collecting and making a herbarium, with appendices on cleaning, staining and leaf prints, and finally philately.

Throughout, the beauty of leaves, of magnified leaf parts and the arrangement of the leaves on a plant as well as of the whole leaf, is the main theme of the illustrations. The book is expensive; but if you have a small coffee table waiting for a book through which one can browse and obtain much visual pleasure and unexpected facets of knowledge on a very functional plant organ that is widespread in the natural world, this would be the book for you.

M. Briggs

Guide to standard Floras of the world. D. G. Frodin. Pp. 619. Cambridge University Press, Cambridge. 1984. Price £95.00 (ISBN 0–521–23688–6).

This remarkable book provides a critical guide to the published work that is available for the identification of flowering plants and ferns throughout the world. The term 'standard floras' is used in the sense coined by V. H. Heywood in connection with the *Flora Europaea* project, i.e. the best works currently available for those seeking information about the plants of any country or similar area. The Guide is authoritative, well arranged and clearly the fruit of a prodigous amount of hard and, one suspects, often unrewarding labour. It takes the form of a select bibliography with annotations in which the works are assessed, almost invariably as a result of the author's own careful examination of the contents. Those who know the author will not be surprised to find that this is no mere juggernaut of bibliographic drudgery, but rather is spiced with informed comment and some idiosyncratic touches that enliven the text. In short, in addition to fulfilling its primary function as a practical guide to prospective Flora users, it is a book that anyone with an interest in floristics or botanical literature can browse in for many hours with considerable enjoyment.

The data are very firmly structured under nine major divisions covering the major continental regions, after which follow sections on the various countries and other territorial aggregations. Chapter headings are accompanied by delightful quotations that reflect the aspirations, achievements and failures of botanical authors. The treatment is exhaustive and highly detailed. Thus, under the British Isles, we learn that the latest work covering Scotland as a country is W. J. Hooker's *Flora Scotica* of 1821, and there is even an entry for Rockall (for which no vascular plants have been recorded). British botanists should note that coverage at the British county Flora level is not provided, a possibility obviously precluded by the world-wide objectives of the book. The geographical breakdown is preceded by three extremely interesting chapters that survey the range of publications that are available, the progress and prospects of Flora writing since 1939, and general considerations on the style of Floras. All those engaged in Flora writing or contemplating initiating projects of this kind should study these essays with care. If more thought were given to what Floras are actually 'for' and how perceived needs can best be met in the real world, botanical libraries would have fewer sad, rusting hulks of major, but over-ambitious works, some of which expired with a bang of recriminations in a glare of publicity, while others subsided in obscurity with scarcely a whimper.

In short, this is a major, highly practical work of reference that should be in all libraries with any pretence towards coverage of botanical taxonomy and related topics. The tone of this review has been deservedly enthusiastic but, sadly, two rather serious reservations must be made. The first is that the cut-off date for entries is 1980, while the publication date was late in 1984. Obviously, it is highly desirable that works of reference should be as up-to-date as possible and, while no doubt difficulties existed, such as the author's present location at the University of Papua New Guinea, four years in press is grossly excessive, even for a publication as complex as the Guide. The book is beautifully designed and produced and is worthy of the best traditions of the Press, but can it possibly justify the staggeringly high price of £95.00? Basic working tools of this kind are especially valuable in the developing areas of the world and in the less well-endowed libraries. One cannot but fear that the cost will preclude its use in many situations where it would be of the greatest value, while the major and more affluent libraries will be held to ransom, and individual purchases will be limited to the very well-heeled. As I have said, this is a very nicely produced book, but it is in no way a luxury publication. Surely it could have been produced more cheaply so that this, coupled with the prospects of wider sales, could have brought the price down? Otherwise, it is difficult to interpret the pricing policy other than as a cynical exploitation of the major scholarly libraries as a captive market, and this is an attitude that one is loath to attribute to such a very distinguished publishing house as C.U.P.

J. F. M. Cannon

Flowers of the Himalaya. O. Polunin & A. Stainton. Pp. xxx + 580, with 128 colour plates, 74 pages of line illustrations, an illustrated glossary and 2 maps (end papers). Oxford University Press, Oxford. 1985. Price £29.50 (ISBN 0–19–217623–4).

The increasing number of B.S.B.I. members who visit the Himalaya on tours should find this long-awaited book of interest, and indeed for many it will be required reading. It is the first popular guide to the flora of the Himalaya, from Kashmir and Ladakh to the Nepal-Sikkim border in the east. Polunin and Stainton have collaborated well in producing a layman's account which retains botanical accuracy.

It is based upon the *Enumeration of the flowering plants of Nepal*, prepared by the British Museum (Natural History) in recent years, and so adopts current taxonomic treatment and nomenclature. Inclusion of a few more synonyms would have been helpful, especially to Indian readers who still follow Hooker's *The Flora of British India*, though this is hardly within the scope of a 'popular' guide. Some 1500 species are described, found mostly above 1200 m in the upper valleys, and in the hills and mountainous regions up to 5500 m. Naturally this is not a Flora, as only a selection of the estimated 9000 species supported by the area covered, can be represented. The 690 colour photographs are generally of a high standard and compare with Polunin's European guides, though inevitably a number are disappointing. Ann Farrer's 315 line drawings add much to this work, being accurate and providing an attractive illustration of a wide variety of families; the inclusion of individual flowers or fruit in detail is to be commended. There is an informative account of where to go plant-hunting in the Himalaya, and at what seasons of the year. Brief descriptions of the influence of climate, geology, soils, altitude and man on the flora are given. A clear glossary of terms will aid the beginner.

The book appears remarkably clear of errors in both original content and preparation. Some of the upper altitudinal limits are incorrect, but this is a reflection of scanty and sometimes inaccurate entries on herbarium sheets.

Oxford University Press have settled on an acceptable price on this occasion (cf. *Flowers of Greece and the Balkans*), but publishers should note that this is very much the upper limit to which even the enthusiast is prepared to stretch.

The authors are to be congratulated on an excellent book which will prove to be a standard reference for decades to come, as it succeeds in covering the common and attractive species encountered by a visitor. A. Stainton is currently preparing a supplementary volume, which will fill in many gaps and give a better representation of the subtropical flora of the region.

C. A. Chadwell

Wild flowers of the Yorkshire wolds. Sylvia M. Arnold. Pp. 85, with 14 black & white photographs and 6 text-figures. Hutton Press Ltd., Beverley, East Yorkshire. 1985. Price (soft cover) £2.95 (ISBN 0–907033–25–3).

The Yorkshire wolds is an attractive area with a rich flora about which little has been written. This small book contains chapters on the various habitats with short lists of species for each. Under the heading 'Facts and Fiction' are given interesting items of information for selected species, including their former medicinal and other uses. There is also a chapter on conservation.

The selection of species to be mentioned in the book appears to be arbitrary. Some rarities are included, whilst species characteristic of wolds habitats and widely distributed receive no mention, notably *Picris hieracioides*, *Galeopsis angustifolia* and *Koeleria cristata*. A few grasses are included, but only one sedge and one rush, so that some of the most interesting species of spring-fed marshes are omitted.

There are minor criticisms and some queries: the Butterfly Orchid that is rare in wolds woods is *Platanthera chlorantha* and not *P. bifolia*. If *Polygala calcarea* has been found on the wolds, extending its known range by sixty miles or more, as recorder I would welcome information; likewise, if there are authentic records for *Dactylorhiza praetermissa* × *D. purpurella*, I should like to know of them. And does *Veronica filiformis* really occur on field margins?

This attractive, well produced book, nevertheless makes interesting reading and is a useful guide to the habitats and wild flowers of the wolds, particularly for the beginner and visitor.

F. E. Crackles

How to make a wildlife garden. J. C. Baines. Pp. 192, with 70 colour photographs and 10 line drawings. Elm Tree Books, London. 1985. Price £8.95 (ISBN 0–241–11448–9).

This apparently simple book does more than fulfill its avowed purpose, it introduces a number of important ecological ideas to the general reader and makes a useful practical handbook for botanist-gardeners. Chris Baines' breezy and colloquial style is surprisingly adaptable; directions and explanations are notably clear, and narrative parts are lively and expressive, rising even to eloquent rhetoric on occasion.

Now that our flora and fauna have to contend with rural as well as urban wastes, it is all the more important to promote the idea of wildlife gardens, particularly for some meadow plants and for creatures such as newts and frogs, and butterflies. Many misconceptions are demolished in the course of this book – that a garden for wildlife is necessarily unkempt and scruffy, for instance, or that simply scattering a packet of wildflower seed over a waste patch will ensure a wildflower garden. Dispensing firmly with the idea that all wild plants behave like invasive weeds, the author explores the preferences of a wide range of species and brings all his skills as a landscape architect into his suggestions for a wild garden.

He shows how even a small garden can contain several habitats, attractive to plants and animals (including human ones). His 'cottage garden service station', close to the house, includes many nectar-rich plants and feeding places for winter birds. A meadow patch, however small, is good for plants, insects and small mammals; and Chris Baines suggests that after the late summer cut, one gives a garden party to achieve the trampling effect of grazing animals – the *only* way to get Yellow Rattle (*Rhinanthus minor*) to self-seed, he avows. A pond is not only desirable but also practicable, if one follows the useful instructions outlined here for making a pleasantly naturalistic one (no crazy paving edges) with grassy slopes to it and a marshy area. There is a useful tip about drip-filling, borrowed from Arab horticulturalists. The woodland edge habitat contains Primroses, Red Campion, Bluebells and Foxgloves as well as some more unusual plants. (From my own experience I would sound a cautionary note about planting Oxlips in proximity to Primroses, for though you get some remarkable hybrids, the Oxlips seem to disappear after a few years). It is good to find that a vegetable patch has a place in this wildlife garden, reinforcing the idea that, in a balanced environment, food plants suffer no more depredations than in any other garden – perhaps fewer.

There are sensible notes about the provenance of bought wildflower seed, on collecting seeds and cuttings, and on growing wild plants, and a useful appendix of societies and nurseries. Throughout the book there is an awareness of the wild garden as a part of a wider system. Larger mammals may come to feed (Chris Baines saw a muntjac one morning in his garden, not many miles from Birmingham city centre), and a place to feed and roost could be a matter of life or death for winter birds, or a vital link in the life cycle of a butterfly or moth. While its specific concern is to encourage people to be active on their own patch, this book looks also to the natural history over the garden wall, and further abroad.

F. Greenoak

Index Filicum – Supplementum quintum pro annis 1961–1975. F. M. Jarrett, with T. A. Bence, J. W. Grimes, B. S. Parris & J. L. M. Pinner. Pp. 245. Clarendon Press, Oxford. 1985. Price £25.00 (ISBN 0–19–854579–7).

Indices that give the original place of publication of plant names are essential tools of trade of the taxonomist. The most familiar of these to flowering plant botanists is *Index Kewensis*, which was launched in January 1882 by the then Director of Kew, Sir Joseph Hooker, who employed B. Daydon Jackson to start work on the project. The work, initially published as two volumes (1893, 1895), with subsequent Supplements published at five- to ten-year intervals, listed all generic and specific names of flowering plants from those of Linnaeus onwards together with their places of publication. Thus *Index Kewensis* set the style for other lists of plant names and stimulated the Danish pteridologist Carl Christensen to compile a similar list of fern names (*Index Filicum*; 1905–06) and later Supplements (1913, 1917 and 1934). The fourth Supplement, covering the years 1934 to 1960, was prepared by a committee of the I.A.P.T. and published in 1965 (*Regnum Vegetabile* Vol. 37).

The book under review is the Fifth Supplement and is again the work of the staff at Kew under the direction of Dr Frances Jarrett, who had maintained at Kew a running index of all fern names published since January, 1960. What is more, she wisely included in her index all pteridophytes (Lycopodiopsida, Equisetopsida, Psilotopsida); in this supplement, and for the first time, the names of fern allies are included. They had hitherto been published separately, at different times, and by different authors. Infraspecific names are not listed except where they provide the basionym for a new name. All entries are cross-referenced to their basionym or the name from which they derive, whilst each basionym is cross-referenced to the name which is derived from it. Like the Fourth Supplement, it is not a nomenclator making taxonomic decisions on synonymy, as did the original work. Preparing a work of this nature for the press is tedious and time-consuming, but this book has been carefully and consistently edited. The compilers have included all papers that have arrived at Kew, and we hope and believe that very few containing new taxa have been missed. Any papers missed in Supplement Five will be included in Supplement Six.

If such works are to be effective they must be the result of an ongoing project, as indeed this now is. Like so many long-term and on-going data files, it lends itself to electronic retrieval/printing techniques. Publication is already ten years behind, and we must hope that more resources can be released for this important work so that the sixth Supplement does not take so long to edit and publish.

A. C. JERMY

Med-Checklist: a critical inventory of vascular plants of the circum-Mediterranean countries, 1 Pteridophyta (ed. 2), Gymnosperms, Dicotyledons (Acanthaceae – Cneoraceae). W. Greuter, H. M. Burdet & G. Long (eds). Pp. c + 330. Conservatoire et Jardin botaniques, Geneva & Secretariat Med-Checklist, Botanischer Garten & Botanisches Museum, Berlin–Dahlem. 1984. Price Sw Fr 98.00 (ISBN 2–8277–0151–0; 2–8279–0004–1).

The preface to this book (in both English and French) explains that the Med-Checklist scheme was set up in 1978 under the auspices of the European Science Foundation and placed under the scientific authority of the Organization for the Phyto-Taxonomic Investigation of the Mediterranean Area (OPTIMA). Most of the compilation is carried out in three centres: Berlin, Geneva and Montpellier, with data derived from a network of regional and national advisors.

Families, genera, species and subspecies are the only formal taxonomic ranks recognized, although the 'aggregate' (informal grouping for convenience) is used. All countries bordering the Mediterranean Sea, together with Portugal, Bulgaria, the Crimea and Jordan, are included. This area is divided into 27 territories, of which the European coincide with those of *Flora Europaea* except for Malta, which is recognized separately from Sicily. The others are the East Aegean Islands (all the Greek Islands not covered by *Flora Europaea*, but included in *Flora of Turkey*), Algeria, Asiatic Turkey (Anatolia), Cyprus, Egypt, Israel and Jordan (combined), Libya, Lebanon and Syria (combined), Morocco, Sinai and Tunisia.

The checklist gives taxa in alphabetical order, and assigns each a complex unique reference number. Authorities and places of publication are given (including the synonyms). The countries are listed across the landscaped page in sequence around the Mediterranean approximately clockwise, starting with Portugal and ending with Morocco. Occurrence of the taxa is marked by a '+' sign, in the appropriate column(s). The work ends with a list of basic Floras, additional references and an index of scientific names.

This work will obviously be an essential work of reference for many botanists, not only for those interested in the Mediterranean; for it covers the whole territory of the countries considered, e.g. all France, not just the Mediterranean part. It is backed up by a series of notulae published at intervals in the periodical *Willdenowia*. These contain many new records and an alarming number of new names and combinations (many sadly lacking any explanation or discussion). Some of the nomenclatural changes are alarming, and the genus *Quidproquo*, a nomen novum with the species *Q. confusum* for *Raphanus aucheri*, is surely the way to give taxonomy a bad reputation.

It is unfortunate that the work is retrograde in that it lumps together all the recent splits from *Lycopodium* which do seem to have gained acceptance. On the other hand A. J. Scott's radical splitting of the Chenopodiaceae is recognized, including therefore the genus *Blitum* for the red-fruited *Chenopodium* species. There is a considerable number of unnecessary deviations from *Flora Europaea*, which cannot help towards a stable nomenclature and will certainly upset the horticulturalists, weed scientists, etc. Some contributors might be seen to appear obsessed by the number of times their name appears as the authority following a taxon.

It should be mentioned that an earlier version of the Pteridophyta alone was published in 1981, in paperback format, and distributed free to members of OPTIMA. A substantial revision of this group proved necessary and it has been republished as a second edition in this volume. It is to be hoped a second edition of the rest will not be necessary, especially as the work costs 98 Swiss Francs (about £32), and a further five volumes are planned. Many of us eagerly await these, as such a vital checklist is long overdue. The work can be obtained from: The Med-Checklist Secretariat, Botanischer Garten & Botanisches Museum, Berlin–Dahlem, Germany BDR.

S. L. Jury

Plant chemosystematics. J. B. Harborne & B. L. Turner. Pp. x + 562. Academic Press, London & Orlando. 1984. Price £65.00 (ISBN 0–12–324640–7).

As the authors point out in their Preface, this book can be considered to be a revised version of Alston & Turner's *Biochemical Systematics*, published in 1963. *Plant Chemosystematics* covers the same field and attempts to review its state and potential up to the end of 1982; it includes two of the opening chapters from *Biochemical Systematics*, but most of the book is entirely new.

The first four chapters of *Plant Chemosystematics* are introductory. Chapters 1 and 4 are brief discussions of the uses, advantages and disadvantages of chemical and biochemical characters in plant systematics. Chapters 2 and 3, dealing with taxonomic and evolutionary principles and perspectives, are reprinted almost without change from *Biochemical Systematics*; they were excellent in the context of 1963, but, as elsewhere in the book, modern views of population structure and the role of selection are not reflected. Chapter 5 opens the major chemosystematic section of the book with a useful but sometimes rather dated account of plant scents and odours, a rather diverse group of volatile compounds with a variety of functions. As in other chapters, most of the material is based on earlier reviews and is in part outdated as a consequence; the section on terpenoid scents and odours is particularly unfortunate, with references to routine techniques of the late 1960s and a 'recent' review published in 1975. Chapters 6 and 7, valuable surveys of alkaloids, some other plant toxins, and plant pigments, are more satisfactory in this respect. Chapter 8, rather misleadingly entitled 'Hidden Metabolites', deals with fatty acids and some other lipids, wax alkanes, polyacetylenes, sugars, and some related compounds. As elsewhere, the impossibility of covering the whole field to everyone's satisfaction is clear; there are, for example no references to the biochemical functions of sugar alcohols and cyclitols.

Chapters 9 to 13 return to a major theme of *Biochemical Systematics*, the use of micromolecular (chemical) characters in studies of plant populations and intraspecific variation, interspecific hybridization, and relationships between species, genera and families. Systematists will find these chapters valuable, although there are, as elsewhere, occasional lapses (for example, nomenclatural confusion in *Baptisia* on pp. 322–323, and the description on p. 309 of the Psilotaceae as "a non-flowering taxon which first appears in the fossil record during the early Palaeozoic"). More cross-references between chapters are needed. Chapter 14, dealing with the comparative biochemistry of metabolic pathways, is interesting but sometimes rather dated (most recent references for lysine pathways 1974, C_3 and C_4 photosynthesis 1978, CAM 1978). Chapter 15, dealing with phytoalexin variation, and Chapter 16, on the analysis and interpretation of chemical data, are brief but useful.

Chapters 17 and 18 deal with the use of macromolecular data from proteins and nucleic acids. The accounts of each topic are relatively brief but provide a good introduction, with references to recent reviews, though not to the excellent symposium edited by Jensen and Fairbrothers (*Proteins and Nucleic Acids in Plant Systematics*, Springer-Verlag, 1983), which appeared too late to be included. There are a few lapses; for example, few biochemists would describe cytochrome c as an enzyme (p. 395 sqq.).

This book cannot be unreservedly recommended as a guide to plant chemosystematics, but it does provide an excellent introduction to many aspects of the subject, with useful evaluations or interpretations of many points. The authors have relied on reviews for most of their general coverage, and as a result much recent work has been omitted. Nevertheless, this book will be a valuable basic reference source to those with access to a copy; unfortunately, its extremely high price will deter sales even to the best-financed libraries.

Q. O. N. KAY

The living Earth. C. Back. 4 parts: 1. Plants and simple animals; 2. Animals with many legs. Animal homes; 3. Animals with backbones; 4. Our planet. Pp. (each) 4 × 64, with numerous colour and black & white photographs and illustrations. A. & C. Black, Ltd., London. 1985. Price (per volume) £4.95 (hardback) (ISBN 0–7136 (all): 2263–6, 2265–2, 2267–9, 2269–5); £2.95 (paperback) (ISBN 0–7136 (all): 2264–4, 2266–0, 2268–7, 2270–9).

These children's books, which have beautiful cover photographs, present a great deal of information in simple form and contain many suggestions for experimentation and investigation by the reader.

However, it is most important that instructive literature for children, as well as being simple, should be accurate. Not every parent, teacher or nanny is able to assess the worth of a scientific book, and it does no service to a young mind to give it wrong or only partly correct information. In these books there are many careless, inaccurate or oversimple statements which may seriously mislead. Some examples are:–

> ". . . during the day and night, plants and animals take in oxygen and give out carbon dioxide. This is called *respiration*." – "Tubers are swollen stems which grow on the roots. Potatoes are tubers." – "Every fertilised flower can develop into a fruit or cone" – "Living things which aren't plants *must* be animals". – "Molluscs – is the word used to describe animals with shells".

The drawings are large and clear but contain mistakes and inaccuracies, for example an ivy plant attaching itself to a wall with roots half as long as the leaves. The fern called *Dryopteris* on p. 22 is shown with peltate indusia, and on the same page the captions for Hart's-tongue Fern and a drawing which is intended to be Broad Buckler Fern are reversed. No idea of scale is given – an *Amoeba* is a quarter of the length of an earthworm illustrated on the same page; similarly *Planaria* and a leech are the same size. There are also a number of spelling mistakes, for example "dulce" for dulse and "scull" for skull!

There is a commendable emphasis on conservation – most of the time. One is enjoined not to pick a leaf or gather a moss, but "if you ever keep tadpoles in a bowl don't forget to put in a stone"!

The final part of *The living Earth, Our planet*, which deals with climate, geology, physical geography and so on and which ends with a sensible plea for conservation on both a local and a global scale, seems better than the others.

I am unable to recommend these books, although they are very well produced with clear drawings and good photographs and look most attractive.

A. LEE

Flora of Jersey. Frances le Sueur. Pp. xlii + 244, with 18 colour plates, 18 black & white illustrations, about 600 distribution maps and 8 maps of physical features. Société Jersiaise, St Helier, Jersey. 1984. Price £17.50 (plus £1.50 p. & p.).

The spice of the floras of the various Channel Islands is their remarkable differences (in animal life too), united though they are by an abundance of special plants – and the absence, or rarity, of others common north of the Channel, another aspect of their differences.

These differences are evidenced in this welcome work by a line after each species summarizing its frequency in the other main islands, as was done in *The wild flowers of Guernsey*, but here is updated. Thus this Flora is a useful guide in the other islands as well.

But of course it is the native and naturalized plants of the largest of the islands that are so well dealt with here. For 30 years or more Mrs le Sueur has been the indefatigable leader of the botanical section, which she revitalized, of La Société Jersiaise. Moreover, she had the advantage of close personal contact with her two most important predecessors, T. W. Attenborough, who had worked on the flora since 1911, and the contentious, curious, Frère Louis-Arsène, with his troublesome herbarium (see *Watsonia* **14**: 167–176, 1982). She organized the island mapping scheme from 1960–1970, which produced the dot maps of all the main species. This is a feature lacking from *The wild flowers of Guernsey* (although such maps existed and were used in writing the text). It is better also in its telling half-page photos, by her elder son, of various parts of the island; and, most strikingly, in its decorative colour plates. It is no mean feat to have produced this Flora with so many of these for so low a price. The whole production looks good, and is good.

The whole-page maps at the end are not all of real use. Most have few names on them and some, e.g. hedgerows and farmland, none at all. The awful gap in this book is of any map showing the numerous places that are mentioned in the text, which renders some of it relatively unhelpful. It is small excuse to suggest that readers should buy an Ordnance Survey map, which inevitably fails to serve the purpose for the opposite reason: there are too many places marked.

Mrs le Sueur is a scholarly, all-round naturalist and has shown great shrewdness in assessing the facts, which are right up to date, of the 1500 or so taxa treated. I can hardly imagine the job being better done. The book is a thoroughly reliable source, a pleasure to browse into, and warmly recommended.

D. McClintock

A simple field key to common British wild flowers. S. M. Arnold. Pp. 125, with 12 plates and many text figures. Lockington Publishing Co., Ltd., North Ferriby, East Yorkshire. 1983. Price £5.00 (ISBN 0–905490–23–1).

I approached this volume in the hope that it would be a very usable key but found it disappointing. Its main problem to my eyes is that it is extremely eclectic without saying so. There is a glossary that is fair, with useful illustrations. The Key, which forms the body of the book, is well laid out but suffers badly from the fact that in only a few cases are you even given a hint that there may be plants other than those mentioned. If one, for example, tried to run down Fringed Water-lily (*Nymphoides peltata*) with this key, it comes out as Yellow Water-lily (*Nuphar lutea*), and there is no hint that this identification may not be correct.

There is a good index of combined English and Latin names, with cross-referencing; but of course it refers only to the plants included. There are twelve half-tone plates of variable quality, and here we find a bad discrepancy. The plates have no legends; for identification of the plants depicted one must turn to the plate index, where each half plate is indicated as simply 'a' or 'b'. These letters, however do not appear on the plates, and the plants indicated are inconsistent, e.g. Pl. 1*a* is the top plant whereas Pl. 3*a* is the bottom one. There is a real need for a simple illustrated key to common wild flowers in Britain, but unfortunately this book cannot be recommended as such.

J. M. Mullin

The Cambridge encyclopaedia of life sciences. Edited by A. Friday & D. S. Ingram. Pp. 432, with numerous colour and black & white illustrations and line drawings. Cambridge University Press, Cambridge. 1985. Price £25.00 (IBSN 0–521–25696–8).

As science has become more and more the province of the specialist, we have seen in recent years a number of books that attempt to give an overview of current thought in the subject. The *Cambridge encyclopaedia of life sciences* is the latest and one of the best of the genre. Compiled by a panel of distinguished contributors, mainly but not entirely working in Cambridge, it covers, in the first part of the book, the natural sciences in a progression from the cell and its work through to the behaviour and ecology of living things in general. The second section is on environments and takes the topic from biogeographical zones to the living organism as host for others. The third section is concerned with evolutionary processes and their results as seen in the fossil record down to recent times, and the final pages give a classification of living organisms.

In such a synthesis, and particularly one that concentrates on processes rather than objects, the treatment is bound to be uneven. There is far more detail, for example, on cells than on the environments that they ultimately form, which often have to be dealt with very superficially. The list of further reading at the end of each chapter in general provides suggestions for filling in the inevitable gaps, but does not provide a single title that would enable a serious student to pursue an interest in coral reefs, to note but one such omission.

The question as to whom such a book is directed is perhaps answered when one glances at the text, where certain words, particularly in the early sections, stand out in heavy type. These are difficult or key words that a student might underline in his notes; and it is probably such readers who will make most use of this book, which for VIth formers and perhaps undergraduate students gives an excellent statement of our current knowledge and opinions of the world about us. Librarians in schools and colleges should find it in great demand. The more general reader might hesitate before spending £25.00, but would find that the basic text, backed up by the many beautiful coloured illustrations and excellent diagrams should give him pleasure as well as information. The botanist pure and simple might feel hard done by, as plants certainly get a smaller percentage of space than they should, perhaps, warrant. Their importance is mentioned in many places but is rarely described in detail; and although one of the editors is a botanist, the zoologists seem to have called the shots. Perhaps this is inevitable, but it would be nice to see a book of this kind in which the plants got a fair crack of the whip.

J. Pope

Guide des fougères et plantes alliées. R. Prelli, with the collaboration and drawings of A. Prelli. Pp. 199, with 79 figures and 3 tables. Éditions Lechevalier, Paris. 1985. Price not given.

For too long France has had no up-to-date account of its pteridophyte flora. Those works that were published in the past have long been virtually unobtainable and of course way out of touch with the taxonomic advances of the past few years. All this makes the appearance of this neatly packaged volume most welcome.

This book is really a slim field guide. The 199 pages make up a book only 14 mm thick including the hard cloth binding. It is not a 'coffee table' book, but a practical fern flora of France, adequately supplied with workman-like drawings and photographs to demonstrate diagnostic characters. In style therefore it is not unlike *Welsh Ferns* (Hyde, Wade & Harrison 1978), although, unlike that book, the balance is towards more illustrations and less text.

Introductory chapters cover the biology of ferns and their classification, reproduction and evolution. The order of species roughly follows that given in *Flora Europaea* but differs in detail. More significantly the Filicales are here treated as one group and not subdivided into the several well known family names, e.g. Hymenophyllaceae, Aspidiaceae, etc. This approach is taken, perhaps justifiably, while botanists sort out and agree on one classification. However, I found the lack of structure to such a large section of the book confusing. Furthermore the arrangement of entries is inconsistent – sometimes a heading and generic characters are given before a section, e.g. *Asplenium* and *Dryopteris*, but more often not, e.g. *Cheilanthes, Hymenophyllum* and *Gymnocarpium*. In the chapter on ecology, most interesting tables of altitude and pH preferences are given for selected species. It would have been fascinating to see all taxa included in these tables.

Within the systematic section of the book, many features will be of particular interest to the British botanist, as the emphasis is on recognition of each taxon – it is not a guide to localities. Clear drawings are given to show differences between the stems of *Diphasiastrum alpinum* and *D. issleri*, among others. Within the genus *Asplenium*, differences between *A. obovatum* (recorded from the U.K. in error) and *A. billotii* and between *A. adiantum-nigrum* and *A. onopteris* are well illustrated. Also, differences between *Polystichum setiferum*, *P. aculeatum*, *P. braunii* and *P. lonchitis* are clearly defined by photographs and line drawings. I found the photograph of *Dryopteris remota* particularly welcome – I now know my spore-raising under this label was not successful! This is one of the few relatively widely distributed hybrids that are illustrated; other rarer ones are simply listed at the end of each genus.

I was sorry to see that the familiar *Cystopteris alpina* has been placed under *C. atrovirens*. This is probably a legitimate change, but there are already too many changes going on – especially among the ferns. A good example of this is the recent and highly confusing revival of *Polypodium cambricum* for *P. australe*. *P. cambricum* is used here as in recent British books – all on the basis of a sterile variety named by Linnaeus which occurred probably only once in the wild. If this name must be used for the Southern Polypody should it not be qualified by adding 'var. *australe*'? Another controversial taxa included here is *Cystopteris dickieana*. This is not a fern widely grown in gardens all over the temperate world originating from the Kincardine coast, but the type with spores somewhat similar to those of the Kincardine plant. In such a difficult genus is one approximating character sufficient to allow two morphologically distinct forms to be joined into one species? For me *C. dickieana* is still endemic to the British Isles.

While protecting *C. dickieana* as one of our very few endemic fern species, it is perhaps appropriate to comment that the North-west European *Hymenophyllum wilsonii* is here recorded as occurring in Africa, Australasia and America. This is not an unusual statement but it is not true. South African plants are placed under *H. peltatum* and certainly differ from European material; no doubt other southern hemisphere material is also distinct.

The bibliography at the end of the book is interesting but not very complete. Two fairly recent works which come to mind are not included, viz. Badré F. *et al.* (1982), Le genre *Cheilanthes* en France, *Webbia* **36**(1): 1–38; and Poirion, L. *et al.* (1967), Pteridophytes de la Côte d'Azure, etc., *Webbia* **22**(1): 21–37. This latter work lists *Osmunda regalis* var. *plumieri* as occurring in southern France. I would have liked to see this variety defined in the present work. Does it differ from the *Osmunda regalis* we have in Britain?

Overall, these minor criticisms will not detract greatly from the value of the book. It is a very welcome new field guide to the ferns and fern allies of France which is likely to be of great value to many British pteridological tourists in France, and elsewhere in western Europe.

M. H. Rickard

Communicating in science: writing and speaking. Vernon Booth. Pp. 68. Cambridge University Press, Cambridge. 1985. Price £3.95 (0–521–27771–X).

If I, as an editor, had dictatorial powers over the authors whose work I edit, I should insist on their reading and inwardly digesting this small paperback. So much good sense regarding the writing of scientific papers (not to mention the advice to speakers) is to be found in these few pages, that all writers on scientific subjects would benefit from reading them and carrying out the instructions and advice that they contain.

Dr Booth's book originated in 1970 as an essay entitled *Writing a scientific paper* and has been gradually enlarged through several editions. It is dedicated to Th. M'Fline, an acronym for *Th*e *M*an whose *F*irst *L*anguage *I*s *N*ot *E*nglish, and its watchword is clarity – how to say exactly what you mean to say without indulging in (to quote a well-known radio programme) hesitation, repetition or deviation. The first and longest chapter, 'Writing a scientific paper', deals with the basics of grammar, punctuation and style that are so often ignored nowadays, sometimes resulting in such gems as "After standing in boiling water for two hours, examine the flask" or ambiguities such as "Lions eat more than antelopes". Then follows good advice on 'Preparation of the typescript and figures' and 'Speaking at a public meeting'. How I wish that everyone who stands up to give a scientific paper (or even merely a slide talk) would read and digest the latter chapter first! In the next two chapters, 'Addressed to those for whom English is a foreign language' and 'An appeal to North Americans', the author comes to grips with difficulties of English idiom and usage, and points out that caring Americans are themselves concerned about the trend towards inelegant writing and pomposity in works emanating from that continent. Complex adjectival phrases (stacked modifiers) such as "Barley root tip cell chromosome aberrations", for instance, tend to stop the reader in his tracks. The work ends with advice on 'Preparation of a doctoral dissertation or thesis' and an annotated bibliography.

I found this a very sound book that was amusing and refreshing to read and well worth the cost.

N. K. B. Robson

Documents floristiques. Tome III. Edited by F. Vignon *et al.* Pp. 203. Institut Floristique Franco-Belge, Station d'Etudes en Baie de Somme, F 80230, Saint-Valery-sur-Somme, France. 1982. Price FF 60 (ISSN 0182–0788). Obtainable from F. Vignon, Secretaire Laboratoire de Biologie Végétale, U.E.R. des Sciences exactes et naturelles, 80039 Amiens Cédex, France.

This part of the "Documents Floristiques" contains, besides some botanical records of more local interest, a series of detailed grid maps of the present distribution of 151 plants in Northern France (from the Cherbourg peninsula eastward) and in Belgium and Luxembourg.

These "précartes" (preliminary maps) are part of a series covering, or planned to cover, the greater number of the rarer of more localized vascular plants of the regions concerned. They incorporate, as far as was possible, all previous records, as well as the results of the survey currently in progress. They include therefore the data already published in the *Atlas de la flora belge et luxembourgeoise* (E. Van Rompaey & L. Delvosalle, 1979), and for the extreme south part of the Netherlands covered by the maps used, data from the *Atlas of the Netherlands Flora* (J. Mennema, A. J. Quene-Boterendbrod & C. L. Plate, 1980).

In the absence of any equivalent of our British National Grid, a grid (of 4 × 4 km squares) has been employed, based upon the Belgian "carte d'état-major" at the 1:40,000 scale, by dividing up each sheet of that map into 40 equal squares; this grid has been extended into the area of France concerned. It has the great disadvantage that it is not printed on the local maps of the territories concerned; we are very lucky to be able to use our clear National grid for mapping purposes so painlessly!

The maps under review cover, in alphabetical order of generic and then species names, the less common species present in the region from *Galeopsis speciosa* to *Lythrum salicaria*. Perhaps the most striking *general* point that emerges from their perusal is that, contrary to what is often supposed in Britain, there has been an even greater decline in N. France and in Belgium than in lowland Britain of many species. This is particularly true of heath and bog plants, for example *Gentiana pneumonanthe*, *Hypericum elodes*, and *Lycopodiella inundata*, all of which are now much rarer than about 50 years ago in N. France and in Belgium, and almost confined to limited areas in the Cotetin in W. Normandy, the Pays de Bray in E. Normandy, the Belgian-Dutch Campine region, and a few scattered sites elsewhere. *Hammarbya paludosa*, indeed, now seems to have disappeared from the whole region covered by the map used (though still persisting in Brittany and the Netherlands); by contrast it is still frequent in our New Forest.

On the other hand, *Halimione pedunculata*, now extinct with us, is still holding its own on the coast between Abbeville and Calais, while *Himantoglossum hircinum* is far commoner in N. France (some 200 localities shown) than in S. England, both on the chalk and on coastal dunes.

Liparis loeselii, though extremely local in N. France, and now almost confined to the dune slacks and fens of the coast from Abbeville to Calais, has there what may well now be the largest and most viable populations of the typical species (as opposed to our western var. *ovata*) left in all Europe except possibly in extreme southern Germany.

Most of the species covered in this work, however, display the distribution patterns one would expect on habitat and climatic grounds; thus *Luzula forsteri*, an Atlantic-Mediterranean species, has a fairly sharp N.E. limit from the mouth of the Somme across to Laon and the upper Seine Valley.

The interesting outliers of the central European calicole flora are well exemplified by the maps of *Geranium sanguineum* and *Helianthemum apenninum*; these species and others are almost confined in the region concerned to the cliffs and chalk grasslands of the lower Seine valley, though the latter also occurs on the limestone cliffs of the Meuse Valley on the Franco-Belgium border. As in Britain, these species appear to be relics of a wider distribution from a time when open, calcareous habitats were probably more widespread, before the forests closed in.

The map of *Gentianella germanica* clearly shows how this species entirely replaces *G. amarella* as the common species of French and Belgian calcareous grasslands. *G. amarella* in N. France is a very rare and declining species of coastal dune slacks; indeed some reputed sites for it produce now only *G. uliginosa*.

Many non-British species are of course included among those mapped, and these cannot be discussed in detail here, except that it is worth remarking that very few of these actually reach the Channel coast, though often common inland, either on the chalk or in such areas as the acid Ardennes forest.

There seems to be few errors, though the outlying Luxembourg localities for *Hymenophyllum tunbrigense*, mentioned in the rubric, are not actually shown on its map, and the occurrence of *Globularia punctata* on the downs of the Somme valley above Amiens is omitted.

The point is made however that these are provisional maps, to which, it is hoped, further field work will add records.

This is indeed an interesting work, which all British botanists interested in the wider distribution of British plants should obtain; the whole series will be most valuable when complete. It is good to see that our French colleagues are now getting to grips with detailed mapping of the flora of at least the north of their country.

F. ROSE

Plant facts and fancies. Sylvia Woods. Pp. 93, with numerous line drawings. Faber & Faber Ltd., London. 1985. Price £5.50 (ISBN 0–571–13436–X).

This short book is essentially Victorian in its approach, both to its subject and its readers. It is suggested that the work should be catalogued under ‘Plant – Juvenile literature’, and in her effort to write for young readers the author stoops to oversimplification and a persistent moralizing tone.

On the whole the material presented is accurate, although as in many books on plant-lore there is a tendency to place in the past superstitions and customs that are still very much alive. Thus, although it is implied that belief in ‘lone thorns’ died out with the advent of mechanical hedge-trimmers, it is still possible to meet people who not only hold the belief that to damage such thorns invites misfortune, but also claim to have seen the fairies associated with the trees. At times it is difficult to know if inaccuracies are caused by a desire to oversimplify or by inadequate knowledge of the subject. Certainly the opening paragraphs of the chapter ‘Naming the flowers’ seem to suggest the latter: “The official botanical names of plants were finally decided in the eighteenth century by a Swedish botanist called Carl von Linné.”

All in all we have a conscientious offering which, though neither inspired nor inspiring, provides half-an-hour’s entertainment.

A. R. VICKERY

Holding your ground. An action guide to local conservation. A. King & S. Clifford. Pp. ix + 326, with 39 black & white photographs and figures. Maurice Temple Smith, London. 1985. Price £5.95 (ISBN 0–85117–250–4).

Here is a book for the desk-top of any conservation worker or group concerned with protecting local wildlife, landscape and old buildings. Angela King and Sue Clifford have produced an ‘action guide’ for Common Ground (an agency concerned with promoting and exploring our common cultural heritage), which contains both character and a thoughtful compilation of valuable information.

After emphasizing the importance of local environment to the fabric of our common culture and explaining the major ways conservation can be put into practice locally, the main text is given over to doing just that. Each chapter deals with a local habitat, for example trees and woodland, summarizing its value. This value is given a broad interpretation: ancient woodlands not only contain a wide diversity of plants and animals but also have landscape and amenity value and historical and cultural interest. This refreshing perspective runs throughout the book and will encourage anyone who picks it up to read on to the next stage: advice and examples of how to turn interest into action.

The chapter on trees and woodland deals with Tree Preservation Orders; felling licences; the survey, purchase and management of conservation areas; tree nurseries and planting; and town trees and grants. At the end of the chapter the statutory agencies are described, and references and further reading are prescribed. This pattern is repeated for other habitats and also for landscapes, monuments and buildings. (There is also a short chapter on the conservation of plants and animals). The character of the book lies in the way the authors have blended together essential information on, say, how to purchase a woodland with an illustration of how this can be achieved, in this case the purchase of Hardings Wood. These examples are written by the local groups responsible for the 'action' and contain not only the essential details but also the local flavour of a project. Ideas and possibilities take shape that to the reader are often little more than pipe dreams. The examples come from a range of trusts, projects, societies and individuals and describe both the successes and the failures.

The final four chapters deal with the organization of local action, collecting and using information, and understanding of local government, and how to achieve financial and physical help.

So often today, in the face of modern decision-making processes, there is a feeling of helplessness – that the control of our environment is out of our hands. This book offers some sound and carefully presented information on how to at least hold your ground. But more importantly, through carefully used examples of local people achieving local success, it kindles the confidence in the reader to join in this success.

P. M. WADE

Ecological Flora of the Shropshire Region. C. A. Sinker, J. R. Packham, I. C. Trueman, P. H. Oswald, F. H. Perring, & W. V. Prestwood. Pp. xvi + 344, with cover paintings and 8 colour plates by Anne Gilbert, chapter headings by Lindsay Brown, 4 black & white photographs and endpapers, 48 text figures, 18 tables, numerous distribution maps and 12 overlay maps. Shropshire Trust for Nature Conservation, Shrewsbury. 1985. Price £23.00 (ISBN 0–9508637–0–X).

To some people, Shropshire may not spring to mind as one of the botanical aristocrats; but it is a big county, and in the hands of this distinguished panel of authors it emerges as a fascinating and varied area, a pleasant hunting ground for the field botanist, and a challenge to the ecologist.

This is not the first county Flora to profess an ecological bias, but there has been nothing on this scale previously. The book is divided into three parts. The first gives an account of the methods used in the present survey, followed by an extensive treatment of the history of botanical recording in the county. The chapter on 'Environmental background' is readable and informative, covering climate, topography, geology, soils and land use. These aspects are treated with considerable academic vigour; for example, much recent work on Shropshire soils is discussed in some detail, and its relevance to the vegetational patterns is considered. Of less value is the table of 'Environmental Profiles', in which certain features are listed for each 10 km square. This seems to have limited relevance, since there is no corresponding vegetational information on a 10 km basis. Twelve selected environmental features have in fact been plotted on a tetrad basis, and these are given as dot maps, which are also duplicated as a transparent overlay, a pocket for which would be useful. The section ends with a short chapter on 'Biogeographical elements', in which one of the authors (F.H.P.) indicates how much our knowledge of plant distribution has changed since the publication of J. R. Matthews' *Origin and distribution of the British Flora* in 1955.

Part Two is entitled 'Habitats and plant communities'. The authors recognize four divisions: open water and wetland; rock, heath and grassland; woodland, hedge and scrub; and disturbed and ruderal habitats; and if you have forgotten what ruderal means, you are advised to think of ruins, rubble, rubbish, railways, roadsides and runways! There follows a chapter in which the author (C.A.S.) summarizes our knowledge of the vegetation of the region in the past, based on pollen analysis, illustrates some fascinating ecological relationships on maps, and argues a convincing case for conservation priorities.

The third part is the traditional systematic account of the vascular plants and their distribution. The area surveyed is a large one, comprising 1100 tetrads; and it was decided to designate common, intermediate and rare species for mapping purposes. About 200 of the common plants are not mapped, neither are the rare plants that occur in fewer than three tetrads. The dot maps are placed with the relevant text, and ecological notes include habitat, associated species, water regime, soil texture, nutrient and base status, pH, microclimatic conditions, biotic factors and reproductive strategies. The book ends with a list of herbaria containing Shropshire specimens, and a gazeteer of place names.

Perhaps the most radical feature of this new Flora is the analysis of the plant records by computer methods. Two ordination techniques have been used: reciprocal averaging and indicator species analysis. In each of the four habitat types, 42 stands are analysed, and the full species/stand matrix is printed. The completed ordinations are then used as the basis for a discursive ecological treatment of each habitat.

There are eight pages of colour illustrations (each dealing with a particular habitat), some attractive sketches introducing each chapter, and a dozen or so aerial photographs with extensive captions.

The area covered by the Flora is "The Shropshire Region", interpreted as Shropshire, plus bits of neighbouring counties to make up a 'tidy' rectangle. Interestingly, the few bits of Shropshire which fall outside this rectangle are not omitted, so we end up with a rectangle plus warts! There have been many critics of this pattern, whom the authors are not afraid to quote. I have some sympathy with the sentiments of one of my fellow Welshmen who remarked " 'Greater Shropshire' indeed; I'd make it the East Riding of Powys!" In fairness however, I must compliment the authors on spelling the Welsh place-names correctly, e.g. Pumlumon.

Who was the cynic who said that the Bible was the only good book written by a committee? This Flora has six authors, but the whole work hangs together effectively. Charles Sinker's compelling prose in the Preface sets the tone for a volume that is both scholarly and readable. It sets a new standard for county Floras.

G. WYNNE

Obituaries

OLEG VLADIMIROVICH POLUNIN
(1914—1985)

Oleg Polunin died in his sleep on 2nd July 1985. A few weeks earlier he had been diagnosed as suffering from Motor-neurone Disease, and he was thus spared much suffering. Indeed, he continued to work, despite considerable weariness, until the day before he died. He was a schoolmaster by profession, but he was widely known even beyond the botanical world as the author of an acclaimed series of *Field Guides* to the flora of Europe and elsewhere. His travelling and writing commitments had not allowed him to work actively on the British or Irish floras for some time, but he had been a B.S.B.I. member for 40 years and he was undoubtedly a major influence on British botanists learning about the flora of Europe and the Mediterranean region.

Oleg was born on 28th November 1914 at Checkendon near Reading in Berkshire. His Russian father and English mother were both artists, who had collaborated with Diaghilev on stage sets for his ballets, and Oleg himself was in many ways less a scientist than an artist with a passionate love of plants and botany. He was educated at St Paul's School, London, from where he went up to Magdalen College, Oxford. He read Botany at Oxford at a time when the chair was held by Sir Arthur Tansley, whose example in field studies and ecology was so great an influence on many younger botanists. Oleg joined the staff of Charterhouse School, Godalming, in 1938 as a Biology master, but was absent from the school during World War II when he served in the Intelligence Corps, travelling widely in the Far East and elsewhere. In 1943 he married Lorna Venning, who was then an actress (and who was to make a substantial contribution to production and costumes of stage presentations at Charterhouse). Their long and happy marriage was a firm basis for Oleg's work and subsequent travels.

Following his return to Charterhouse in 1946, Oleg threw himself enthusiastically into teaching. Many Carthusian naturalists and biologists owe a great deal to his encouragement, enthusiasm and example, for his teaching went far beyond the bounds of the classroom. An important feature of the post-war years at Charterhouse was a summer camp for Carthusian biologists run by Oleg and Lorna, accompanied by their young family, Ivan and Natasha, at Lough Ine in Co. Cork. As well as introducing the boys to the Irish countryside and its natural history, these visits resulted in a valuable floristic inventory of Sherkin Island and other islands off the coast of south-western Co. Cork (v.c. H3, West Cork), published in *Watsonia* **1**: 359–363 (1950).

Later Charterhouse biologists' expeditions visited the Isles of Scilly, where Oleg was accompanied by another great enthusiast, the late Percy Chapman, who taught the fabulous mysteries of rockpools and their varied inhabitants. The Biology Department at Charterhouse flourished during the era of this benign and scholarly partnership. Oleg made further floristic contributions in Scilly and during the 1950s he was B.S.B.I. recorder for West Cornwall (v.c. 1). He also wrote an account of the vegetation of the islands, *Some plant communities of the Scilly Isles* (1953), in the form of a mimeographed handout to his pupils. This useful document is now very rare and I know of only three copies! Oleg was an active contributor to the B.S.B.I. *Atlas* mapping scheme, and 'his' 10 km square, based on Godalming, had a higher tally of species than any other in the British Isles.

A consequence of this active field work was that Oleg collaborated with many professional botanists and, during a visit to the British Museum in 1948, to check specimens from Sherkin Island, he was invited by Sir George Taylor, then Deputy Keeper of Botany, to accompany Major H. W. Tilman's 1949 expedition to Nepal as the group's botanist. He thus became one of the few botanists to visit that country since Sir J. D. Hooker one hundred years before, and the first westerner to make extensive collections there since I. H. Burkill in 1907 and Col. F. M. Bailey in the 1930s. In 1952 he took part in a wholly botanical expedition to Nepal, with W. R. Sykes and L.

H. J. Williams, under the joint auspices of the British Museum (Natural History) and the Royal Horticultural Society. From then on Oleg travelled extensively, to Turkey in 1954 and 1956 (with Peter Davis), Kashmir in 1956, Iraq in 1958, Lebanon in 1959 and the Karakorum in 1960 (with the Anglo-American Karakorum Expedition), collecting herbarium material and living plants and seeds. These expeditions were written up in various articles in *Journal of the Royal Horticultural Society, Gardeners' Chronicle* and elsewhere. An eager traveller, he was happiest when on the road, especially, from the 1960s onwards, in the company of Lorna in their camping van. This vehicle was equipped with an outside rack for drying plant-presses, a small library, cooking facilities, good food and drink as available locally, and various tables, chairs and awnings to make an outdoor study. Many friends joined this long-running roadshow, sleeping in tents or even, as Oleg preferred, in the open under the stars; such was my own introduction to the Greek flora in 1970. Oleg and Lorna made an excellent team, he writing, collecting and photographing, she shopping in several languages and feeding and watering the absent-minded scientist. Both absorbed with great vigour the countries through which they passed, making many new friends.

Further opportunities for travel were furnished from 1960 by a number of 'special interest' tour operators, who engaged Oleg as guest lecturer to instruct their clients on holiday. This enabled him to see large areas relatively cheaply. Oleg's tours concentrated on cruises in the eastern Mediterranean, notably in the Greek Islands, and pony-treks in Kashmir and Nepal in the Himalaya. More recently he accompanied tours to the Caucasus, a successful reunion with Mother Russia; sadly he never had the time to develop that area of interest, but he was very thrilled by the region.

He took early retirement in 1972 to devote himself to the writing of his famous series of *Field Guides*. *Flowers of the Mediterranean* (1965, with Anthony Huxley) and *Flowers of Europe* (1969) set the pattern of these remarkable volumes, that combine scholarship with an appreciation of the aesthetic side of botany, and an understanding of the needs of the amateur or novice. *Flowers of South-west Europe* (1973, with Bill Smythies) was the first of the series to give descriptions of individual areas where rare or interesting plants may be found, and it is these regional accounts, above all, that reflect the author's love and rapt enthusiasm for his material. *Flowers of Greece and the Balkans* (1980) and *Flowers of the Himalaya* (1984, with Adam Stainton) were perhaps the volumes that gave Oleg the greatest emotional satisfaction, and his fondness for the flora, scenery, peoples and culture of both regions radiates vividly from the written page. Most of these *Guides* have been translated into several languages and they comprise a worthy and lasting memorial to their author. An important aspect of the *Guides* is their emphasis on conservation, a cause that Oleg embraced long before it became as intellectually respectable as it is today.

The long sections of plates in these books, of colour photographs taken mostly by the author, have set a new standard for publications of this type, and the line drawings, notably those illustrating groups of species characteristic of an area or a habitat, were chosen with care and executed by skilled artists. From the very first, Oleg was a champion of *Flora Europaea*, itself another outstanding achievement of floristic botany, and the *Field Guide* series to a large extent derived from, and forms a valuable accompaniment to, its volumes, to which it provides an unofficial companion series of illustrations and background information. The Polunin books have certainly served to introduce *Flora Europaea*'s overall view of the continent's flora to a wider and less specialized public. Oleg made a direct contribution to the *Flora Europaea* project by sending his herbarium collections to Leicester University herbarium (**LTR**), where members of the *Flora* team identified them "after tea", and these collections remain an important element in that herbarium. Oleg always worked closely with professional colleagues in Britain and abroad and checked any queries or difficulties with them. Some professional botanists have occasionally carped at the *Field Guides* for not giving fuller coverage of particular taxonomic groups, but these books have been widely and profitably used by both amateurs and professionals. *Flowers of the Mediterranean* and *Flowers of Greece and the Balkans*, for example, are the only accessible, authoritative texts on the general Greek flora that are currently available. Oleg set out to educate, not to have the final word on the subject.

His considerable achievements were honoured by the award of the Royal Horticultural Society's Veitch Memorial Medal in 1962, for introducing garden plants of quality, and their Grenfell Medal in 1969 for the photographic plates in *Flowers of Europe*; and by the award of the Linnean Society of London's H. H. Bloomer award in 1983, for an outstanding contribution by an amateur biologist. He is commemorated in the specific epithets of an *Aristolochia*, a *Pedicularis*, a *Primula*, a *Ranunculus* and a *Saxifraga*, also those of an aphid and a frog!

When he was not travelling, Oleg had a secure home base in Godalming, for a long time at "Dormers" (formerly the home of Julian and Aldous Huxley, whose father had taught at Charterhouse), and latterly since his retirement in a roomy flat at the top of Frith Hill (near to where Alfred Russell Wallace had lived for a while). Here he worked, surrounded by books and cabinets of his colour-slides, in a study that looked out on to the Surrey hills where he loved to walk in the afternoons as a break from writing. In recent years he had less time to devote to our own flora, but it was always a source of considerable pleasure to him. A walk around Charterhouse Copse or the marshes of the River Wey in early spring would fill him with delight, and he would exclaim happily at the first show of Sweet Violets or Marsh Marigolds. The artist in him was never far below the surface. He lived amongst his collection of paintings, many by family or friends, and amongst rugs, ornaments and sculptures picked up on his travels in the East. He was a gifted potter and enjoyed presenting his friends with his wares – frequently robust cooking or eating utensils of indispensable practical value as well as artistic elegance. In order to unwind from the discipline of writing, he had a fondness for loud, wild dance music from the Balkans to India or beyond. It was splendid to enter Oleg's study after he had finished a day's work and to see the scholar dance an impromptu jig to bagpipes, zurna or bouzouki! He worked hard and played hard.

Above all, Oleg had a genius for friendship. The Polunins' home has always been an open house to family, neighbours and visitors, representing a wide range of interests. Many of his large circle of friends were present at Charterhouse just before the end of 1984 for his 70th birthday celebrations. One is left with a lasting image of a big, handsome, genial and kindly man, pleased to talk to anybody, and deeply in love with everything he did. Those who knew him will miss him badly, but we are all richer for his teaching, his friendship and his unique and special contribution to floristic botany.

J. R. Akeroyd

ESTHER DORIS PUGH
(1910—1985)

Doris Pugh, a B.S.B.I. member since 1967 and Recorder for Monts., v.c. 47, since 1977, died on 16th February 1985, having suffered a stroke the previous September.

Doris lived practically all her life in the village of Pant on the Shropshire–Montgomeryshire border. Daughter of the village postman, she taught at the Llanymynech primary school from the early 1930s until her retirement, and she was also a pillar of her local Methodist Chapel.

Everyone in the botanical world seemed to know Doris. All over the country I have met people who remember with pleasure the superlative flora of Llanymynech Hill or the Breidden or of almost any other part of this unique and precious corner of Britain. They also remember with almost equal pleasure taking tea and 'grannie's crunch' on Doris's lawn and the rarities which seemed to spring up by magic in her garden. Doris seemed to know every plant in field and hedgerow as a personal friend, and yet, at the end of a day in the field, her little posy of 'bits' nearly always included a new record or the key to an old mystery. Always modest, and even shy, with a warm and wry sense of humour, she taught us all, from expert to tyro, and generally made us think we were teaching her.

In 1977 the first ever comprehensive plant list for v.c. 47 was published. Edited by M. Hignett and W. S. Lacey, it was largely compiled by Doris from the records of Janet Macnair, a previous Recorder for v.c. 47. By this time she had become a prime but self-effacing mover in the Shropshire Flora project, for which she was a tireless worker throughout the 1970s and 1980s. She did not quite live to see the Flora published, but the editors never missed an opportunity to show her each new chapter, each new illustration, as they were produced. The pages are liberally sprinkled with her observations, and many of the recorders for the Flora learned their trade in Doris's kindly hands.

When this task was finished Doris plunged without hesitation into the preparation of a new Flora of Montgomery, and those of us who have helped a little have been amazed at the skill and efficiency with which she has conjured up a viable and enthusiastic team of recorders in this sparsely populated area. A Flora for v.c. 47 will be yet another lasting monument to this extraordinary lady.

We will all remember Doris. I will remember her at the end of many a day's recording, still fresh after scrambling through thickets, climbing over fences, and protecting us from farmers (she seemed to know them all). She would be miles behind down the path, she would have seen everything we had seen and more, a dumpy little grey-haired lady of inestimable value. How we will miss her!

I. C. Trueman

Reports

ANNUAL GENERAL MEETING, 11TH MAY 1985

The Annual General Meeting was held in the Department of Chemistry, University of Reading, at 12 noon, with 93 members present. Mr J. F. M. Cannon F.L.S., retiring President, took the Chair and opened the meeting by thanking Professor V. H. Heywood and B.S.B.I. members on the staff of the Department of Botany, Plant Science Laboratories for the use of the Department's facilities and for the excellent organization of the programme.

Apologies for absence were read, and the adoption of the Minutes of the last Annual General Meeting, as published in *Watsonia*, **15**: 295–296 (1985), was proposed by Dr H. J. M. Bowen, unanimously approved by the meeting, and signed by the President.

REPORT OF COUNCIL

Following the adoption of the Report for the calendar year 1984, proposed by Mrs J. G. Dony, seconded by Mr M. G. Young and carried unanimously by the meeting, the President invited Dr P. M. Wade, Chairman of the B.S.B.I. Conservation Committee to report on the progress of plans to appoint a botanical conservation officer. Dr Wade outlined the current position on the formation of a Conservation Association of Botanical Societies, and answered questions from members on this new development. The meeting gave general approval to the plans, indicating by show of hands a clear majority in favour of an appointment as reported. The retiring President thanked Dr Wade and the sub-committee for the great deal of work involved in the preparation of the final proposals which had incorporated a diversity of ideas through the development of the planning.

TREASURER'S REPORT AND ACCOUNTS

The Treasurer proposed the adoption of his Report, which was seconded by Mrs M. Burnip and carried unanimously by the meeting.

MEMBERSHIP SUBSCRIPTIONS

Due notice having been given of a recommended increased subscription rates as follows – Ordinary £12.50, Junior £5.00, Family £1.00 and Subscriber £12.50, from 1st January 1986, the Treasurer proposed adoption. This was seconded by Lady Anne Brewis and carried by the meeting.

AMENDMENT TO RULES

The Honorary General Secretary introduced the recommended amendments to Rules 3, 4, 6 and 7, to rationalize representation on Council and to reduce the size of Council:

– Rule 3, to read: The management of the affairs and property of the Society shall be in the hands of a Council consisting of: (a) The Honorary Officers, nominated by Council and elected (or re-elected) by members at the Annual General Meeting (length of service as in Rule 9). (b) The Honorary Receiving Editor *Watsonia*, the Honorary Editor *B.S.B.I. News* and the Honorary Field Secretary, appointed annually by Council. (c) The Honorary Secretaries of the five Permanent Working Committees (Rule 4), elected annually by members of the appropriate Committee (Schedule II, 2b). (d) Twelve members elected at the Annual General Meeting, according to Rule 10, and Regional Representatives according to Rule 11 (no change).

– Rule 4, Permanent Working Committees: delete (c) Junior Activities (but add to Meetings Committee terms of reference, Schedule II. A representative to consider how the Society can make known its activities to, and cater for, young botanists and beginners, shall be nominated by the Committee as an *ex officio* member).

– Rule 6, to read: The Officers of the Society shall be the President, not more than four Vice-Presidents, an Honorary General Secretary and Honorary Treasurer.

– Rule 7, Officers' duties: delete (c) Honorary Meetings Secretary, (d) Honorary Field Secretary and (f) Honorary Membership Secretary. (e) Editors, to read: The Honorary Receiving Editor of *Watsonia* and the Honorary Editor of *B.S.B.I. News* shall be *ex officio* members of Council. All Editors of the Society's Journals shall be *ex officio* members of the Publications Committee.

The Treasurer explained the addition to Rule 24 for possible future implementation as follows – Rule 24, add: Council to have the power to reduce the annual subscription for any member paying by Direct Debit.

The adoption of the amendments to these Rules was proposed by Mr A. L. Grenfell, seconded by Mrs M. E. S. Farrand, and carried by the meeting.

ELECTION OF OFFICERS

The retiring President, Mr J. F. M. Cannon, proposed the election of Mr D. E. Allen M.A., F.L.S. as President. This was carried unanimously with applause and Mr Allen, taking the Chair, commented that his election added a small facet to the history of the Society as he was the first ex-Junior Member to be President. From the Chair Mr Allen proposed Dr N. K. B. Robson F.L.S. for election as Vice-President; Mrs M. Briggs M.B.E., F.P.S., F.L.S. for re-election as Honorary General Secretary and Mr M. Walpole for re-election as Honorary Treasurer, referring to these as the 'king-pin posts' for the Society. These were carried unanimously with applause.

ELECTION OF COUNCIL MEMBERS

In accordance with Rule 10, nominations had been received for Dr J. R. Akeroyd F.L.S., Dr C. J. Cadbury and Mr H. J. Noltie. Their election was proposed from the Chair and carried unanimously.

The new President expressed thanks on behalf of the Society to all the Honorary Editors and Secretaries (now, following the amendment to the Rules above, *ex officio* members of Council) for their very considerable work for the society:

Honorary Editors: Dr J. R. Akeroyd F.L.S., Dr B. S. Rushton, Dr R. J. Gornall, Mr C. D. Preston, and Dr N. K. B. Robson F.L.S. (Editors *Watsonia*), and Dr S. M. Eden (retiring Editor *Watsonia*), Mr D. H. Kent (Editor *BSBI Abstracts*) and Mr E. D. Wiggins (Editor *B.S.B.I. News*).

Honorary Secretaries: Mr J. F. M. Cannon F.L.S. (Co-ordinating Committee), Mrs J. Robertson (Meetings Committee), Mr R. Smith (Field Meetings), Mr A. O. Chater (Publications Commitee), Miss L. Farrell (Conservation Committee) and Mr D. J. McCosh (Records Committee).

Mr Cannon was thanked for his good offices during his Presidency, in particular for his guidance during the planning and discussion on two major projects which had the potential for far-reaching influence on the Society – the appointment of a Botanical Conservation Officer, and a new B.S.B.I. Survey project.

RE-ELECTION OF HONORARY AUDITORS

The Honorary Treasurer, expressing our gratitude to Messrs Thornton Baker for auditing the Society's accounts, proposed their re-election. This was carried unanimously.

ANY OTHER BUSINESS

Mr R. M. Burton asked when a new list of members would be available, and Mr J. Ounsted enquired if a larger typeface could be used. The Honorary General Secretary hoped that a list could be printed before the end of the year, and the Honorary Treasurer would look into this possibility. The print-size request was noted, but would be dependent on costs.

Dr P. Macpherson, Secretary to the Committee for Scotland, asked for news of the field recording cards for Scotland in preparation by the Biological Records Centre and now three years behind schedule. The Honorary General Secretary would again enquire for these.

The Honorary Treasurer reported that there would be a delay in publication of *A Map Flora of Mainland Inverness-shire*. There being no further business the meeting closed at 12.59.

M. BRIGGS

PAPERS READ AT THE ANNUAL GENERAL MEETING

THE PARK AT WHITEKNIGHTS

For those with a sense of the whimsical, Whiteknights has a delightful history. This is particularly true of the period 1798–1818 when the park was owned by the Marquis of Blandford, who ornamented the estate in a most elaborate way with fountains, pavilions, bowers, vineyards, statues and all the latest exotic plant introductions. By 1818 the Marquis was bankrupt, his debts to one nurseryman alone amounting to £15,000. Much of this detail we know from a lavishly illustrated book by a Mrs Hofland.

Today, the same site has 34 academic buildings and five Halls of Residence. The area totals 300 acres including woodlands, lakes and meadows as well as the more formal gardens around the many buildings. In many ways, the University is a small town, with all the associated problems of access, parking, services, etc., and many modern buildings requiring bold landscaping. The park also caters for the recreation needs of both students and staff including formal sports as well as jogging, fishing and walking. Many appreciate the conservation aspects of the park and in particular the many birds it attracts. Although little of the original Blandford garden remains, some areas such as the Wilderness with its grotto can still be seen as a historic landscape. Recent sponsorship by the Manpower Services Commission for a two year community project has enabled us to partially restore the Wilderness and carry out long-neglected conservation work.

In general the central areas have been treated formally, with mown lawns and neat shrub borders of exotic plantings, all maintained using modern methods including much mechanization and herbicides. The many mature and rare trees need constant care to keep them safe and healthy. New plantings comprise shrubs, trees and groundcover for ease of maintenance, but the extensive range of plants we use continues the tradition of imaginative planting which has always been encouraged by the University because of its various plant-associated courses. By contrast, the conservation area is relatively undisturbed, with the meadow areas being cut once a year for hay, brambles contained and trees trimmed only when safety demands. New plantings are of predominantly native species and the wild flora is encouraged to develop.

It can therefore be seen that any management plan has to be both complex and flexible to allow for the many uses and needs of a community which is both genuinely critical and constantly changing.

I. K. S. Cooke

CHANGES IN THE BERKSHIRE FLORA

The plants of Berkshire, v.c. 22, were the subject of Floras by G. C. Druce in 1897 and myself in 1965. They have obviously been affected by many changes in land-use over the last century, for while the area of woodland has remained more or less constant, at 10% of the total, much arable land reverted to grassland during the period 1870–1939. Much grassland was ploughed in 1940 and has remained arable ever since.

Woodland species have shown some changes which are not easily explained. Thus *Sorbus torminalis* is much commoner than it was in Druce's time, and *Rhododendron ponticum* (unrecorded by Druce) has colonized half the grid squares in the county. However *Colchicum autumnale* has gone from about half Druce's sites, and *Orchis militaris* became extinct around 1907. Heath vegetation, usually maintained by fire, has suffered from encroachment by farmers and builders. Few species have been completely lost, apart from *Orobanche rapum-genistae*; the alien *Odontites jaubertiana* colonized two heathy sites about 1945, but is nearly gone now. Bog vegetation is all declining as the habitat is lost, and *Gentiana pneumonanthe* was lost over 100 years ago, though it survives nearby in north Hampshire.

The better chalk grassland sites are partly protected in reserves, where *Pulsatilla vulgaris* and *Orchis ustulata* survive, but *O. simia* is extinct and *Spiranthes spiralis* remarkably rare. Other grassland species have declined due to ploughing (e.g. *Genista tinctoria* and *Orchis morio*), grazing or lack of fallow (e.g. *Echium vulgare* and other biennials), but *Lupinus arboreus* is an introduced species which is spreading.

Most plants of wetlands, including drying mud, are in decline, though *Parentucellia viscosa* appeared for the first time in 1969 and *Cyperus fuscus* was refound in 1982. *Ranunculus lingua* and *Fritillaria meleagris* are examples of declining species that it would be sad to lose. Many arable weeds are vanishing due to improvements in agriculture. *Adonis annua* probably survives, but *Agrostemma githago*, *Arnoseris minima* and *Bupleurum rotundifolium* have not been seen recently. The total number of extinctions in the county lies between 40 and 55 species.On the other hand, since 1965 eight new native species have been added to the flora and eleven 'presumed extinctions' have been refound.

H. J. M. Bowen

THE PLANT SCIENCE BOTANIC GARDEN

The Botanic Garden and the adjacent Experimental Grounds were founded in 1972 and reorganized, following the acquisition of additional land, in 1975. Today the Garden occupies some eleven acres and the Experimental Grounds two and a half acres. The Garden is set in what was the home paddock of a Victorian house called "The Wilderness" (now demolished), which had itself been part of the garden of the Marquis of Blandford. The main aims of the Botanic Garden are to provide a scientifically organized collection of plants for teaching and research, to maintain conservation collections of selected groups of plants, to play a general educational role for the public, and to provide an amenity for the University and local residents.

The policy of the Garden is to build up its collections from wild material of known origin and it specializes in plants of Europe and the Mediterranean region, together with North America, temperate South America and Asia. The Garden is a member of I.U.C.N.'s Botanic Gardens Conservation Co-ordinating Body, an organization set up to encourage exchange of information between Botanic Gardens and the I.U.C.N. data-base on threatened plants at Kew. The Garden holds, for example, a number of threatened, narrow endemic plants such as Cretan Date-palm (*Phoenix theophrasti*), various arborescent species from the Canary Islands, and *Brighamia citrina*, a curious, campanulaceous plant with a woody, bottle-shaped stem, from Hawaii. It is a member of the National Council for the Conservation of Plants and Gardens National Collections Scheme, and holds a collection of *Iris*.

Features of the Garden include a herb bed, planted with culinary herbs that are commonly used in this country; a variegated plants bed, with a demonstration of variously coloured foliage and 'true' variegated plants; a rose border, underplanted with herbaceous and ground-cover plants; a woodland walk, managed to encourage the native ground flora, including massed bluebells, wood anemones and celandines, in spring; a fern glade, with a planting of early-flowering woodland plants such as *Helleborus*, *Galanthus* and *Polygonatum* species, with species of *Athyrium*, *Cystopteris*, *Dryopteris*, *Osmunda*, *Polystichum* and other ferns; and a meadow, down to grass for many years and cut in late summer. There are many specimen trees, as elsewhere in the University Park, including a magnificent Cypress Oak (*Quercus robur* forma *fastigiata*).

The Plant Science Botanic Garden holds a number of Open Days during spring and summer, but is also open to interested visitors by arrangement.

V. H. Heywood

EXCURSION TO STRATFIELD SAYE AND MOOR COPSE, BERKSHIRE, HELD IN CONJUNCTION WITH THE ANNUAL GENERAL MEETING, 12TH MAY 1985

61 B.S.B.I. members and their guests made up the party for this meeting, which left the Plant Science Laboratories, University of Reading, by coach at 11.30 hrs. Our morning stop was at Stratfield Saye, where an area of alkaline water-meadow by the River Loddon supports a fine population of Fritillaries (*Fritillaria meleagris* L.), a floristic 'speciality' of the Thames Valley. The meadow clearly shows the pattern of former dykes and drains by which it would have at one time been flooded during the early part of the year, in order to keep frost off the young grass and to encourage growth ('early bite') on which grazing animals might feed in March and April (whilst avoiding the toxic and unpalatable *F. meleagris*). The animals were then removed and a crop of hay was harvested in July to August, by which time *F. meleagris* had shed its seeds. On our visit, the meadow was dotted with the purple, and white, flowers of the fritillaries, an astonishing spectacle for those who had not seen such a meadow before. Flowering had been held back by cold weather, giving us a better display than is usual in mid-May. The continuing unseasonal weather gave

overcast conditions which unfortunately acted against the photographers' interests. Some fine patches of *Ophioglossum vulgatum* were admired: this is another characteristic species of these meadows. The party then moved on to Pangbourne where we sought lunch or ate our sandwiches near the river. The organizers accept no responsibility for the Sunday closure of the public conveniences in Pangbourne!

After lunch we drove 2 km to Moor Copse, a woodland reserve of the Berkshire, Buckinghamshire and Oxfordshire Naturalists' Trust (BBONT). This reserve is an area of some 27 hectares of rather wet woodland of standard oaks and ashes, and coppiced alder, ash and hazel, together with a section of the River Pang, an unpolluted chalk-stream. BBONT, who were fortuitously holding an Open Day (with associated refreshments, exhibits and parking areas) on our visit, have maintained a programme of regular coppicing since the reserve was established in 1975. The spring flora was a magnificent sight, with sheets of *Glechoma hederacea*, *Hyacinthoides non-scriptus*, *Orchis mascula*, *Polygonatum multiflorum* and *Viola riviniana*. For a while the sun shone, but at tea-time a heavy shower drove us under cover. However, this did not spoil the day, which had been a most pleasant mixture of the aesthetic and the scientific aspects of our subject. Following our return to Reading, several enthusiasts carried on their botanical studies in the herbarium and the meeting did not finally break up until 18.00 hrs.

We should like to express our thanks to Dr H. J. M. Bowen, who smoothed our path in the Chemistry Department on the Saturday; to Mr D. Farmer, who handled the A.G.M. paperwork on our Sirius micro-computer and who served refreshments on the Saturday; to Dr D. M. Keith-Lucas and Mr D. J. N. Hind, BBONT as well as B.S.B.I. members, who acted as our liaison with the Trust and who handled queries about Moor Copse from members; and, especially, to Mr M. F. Watson, who helped with refreshments and carried out many of the seemingly trivial but essential jobs that need be done behind the scenes at an A.G.M.

J. R. Akeroyd & S. L. Jury

FIELD MEETINGS, 1984

ENGLAND

VALE OF AYLESBURY, BUCKINGHAMSHIRE. 26TH–27TH MAY

Due to the tragic death of Jeremy Milton, Field Secretary, less than two weeks before the meeting, the arrangements were not finalized and in consequence there was a very poor attendance of only four members during the weekend. The weather too was miserable, as it started to rain on the Friday evening and never stopped until we left Waddesdon on Sunday evening. But while getting wetter and wetter the four recorders were almost overwhelmed by the number of Black Poplars, mostly pollards, in every tetrad examined; but this small team was able to cover only a fraction of the area which needs to be surveyed.

In spite of the adverse circumstances the meeting was useful as it confirmed my feelings that the Vale of Aylesbury is rich in *Populus nigra*, and I now have the task of trying to discover the reason why.

E. Milne-Redhead

NORTH LINCOLNSHIRE. 17TH JUNE

Two areas were visited on the North Lincolnshire meeting: the National Nature Reserve at Saltfleetby Theddlethorpe – with a great diversity of coastal sandy and wetland habitats, and the local County Trust Reserve at Messingham – disused sand quarries with a fine series of inland sandy and wetland habitats in early stages of colonization. In both reserves the writer, as leader, was aided by the expertise of two friends, the wardens: Tim Clifford of The Nature Conservancy Council and Vi Wilkin, Honorary Warden for Messingham. 14 members and friends were present.

Our field secretary, Jeremy Milton, was intending to make this his first Lincolnshire expedition, and the party were saddened to hear of his tragic death.

The spectacular show of marsh orchids was a striking introduction to the Saltfleetby Reserve, with *Dactylorhiza incarnata*, *D. praetermissa* and *D. fuchsii* and hybrids. Tim pointed out the new colony of *Epipactis palustris* (second site for both vice-counties) and commented on the objectives and management of the reserve as a whole, including the problems of Natterjack Toads!

The extensive fresh-water marsh at Saltfleetby can be split into quite distinctive areas with different associations and dominants. In the marsh orchid area other notable plants included *Juncus subnodulosus*, *Hydrocotyle vulgaris*, *Ranunculus flammula* and *Equisetum palustre*, and on the drier parts *Ononis repens* (not common on the Lincolnshire coast). In the parts where conditions are brackish, large areas of *Juncus maritimus* with *Juncus gerardi*, *Samolus valerandi*, etc. occur and, in the deeper, rich, fen-type areas, very extensive stands of *Carex riparia* and *Rumex hydrolapathum*, with *Iris pseudacorus*, *Scutellaria galericulata* and *Lycopus europaeus* are found. (Other notable plants included *Triglochin palustris*, *Eleocharis palustris*, *E. uniglumis* and, quite out of context, the newly recorded *Eriophorum angustifolium*).

The party then crossed the large dune ridge, dodging through dense *Hippophaë rhamnoides* scrub to the landward edge of the salt marsh where a new brackish slack is developing. Near the path, *Eleocharis quinqueflora* was found and the party spotted some new sites for *Dactylorhiza praetermissa*. Returning on the seaward side, saltmarsh plants included *Juncus maritimus*, *Armeria maritima*, *Plantago maritima*, *Glaux maritima*, *Triglochin maritima*, *Limonium vulgare*, *Scirpus maritimus* and *Parapholis strigosa*.

After lunch, the party explored the northern edge of the reserve and found *Carex extensa* (not common in the east), *Blysmus rufus* (southern limit) and *Thalictrum minus* subsp. *arenarium*. The flora on the base-rich sand dunes included *Rubus caesius*, *Carlina vulgaris*, *Anacamptis pyramidalis* and notably *Cerastium arvense*. The Bee Orchid monitoring site was also examined.

Then, taking leave of Tim and wishing him well on his new appointment, several members drove across Lincolnshire for a brief visit to the British Industrial Sand Quarries at Messingham, a recently acquired Lincolnshire Trust Reserve. This reserve supports one of the largest populations of *Pilularia globulifera* in Great Britain. This species is colonizing new areas at an amazing rate. At its original site the species had a very luxuriant growth and a large list of associated plants was made. Altogether the plant list for the reserve was most extensive and with Vi's enthusiasm one really needed another day. *Amsinckia lycopsoides*, present in quantity last year, was not found but *Anagallis tenella*, *Isolepis setacea* and *Samolus valerandi* were notable. So also were the large specimens of *Dactylorhiza praetermissa* in newly colonized areas.

Perhaps it was ambitious to try to do justice to both these areas in a single meeting but it served as a comparison of, and as an introduction to, two very rich sandy areas in Lincolnshire. The comments of the wardens relating to management policies and to the problems of maintaining populations of individual plant species were invaluable and very worthwhile, and the meeting was enjoyed by all.

I. WESTON

DALBY, YORKSHIRE. 23RD JUNE

24 members took part in the meeting, the object of which was to examine in detail the vegetation of three fens on the southern edge of the North Yorkshire Moors National Park. Characteristic species of these fens include *Pinguicula vulgaris*, *Pedicularis palustris*, *Triglochin palustris*, *Juncus subnodulosus*, *Schoenus nigricans*, *Carex hostiana* and *C. lepidocarpa*.

The first site visited at Seive Dale Fen is noted for its extensive population of *Epipactis palustris*. Abundant leaves of this plant were noted, but it was too early for flowers. Orchids noted in flower were *Gymnadenia conopsea*, *Dactylorhiza fuchsii*, *D. maculata* and *D. incarnata* subsp. *pulchella*.

At the second site in Sand Dale, *Eleocharis quinqueflora* and *Eriophorum latifolium* were noted and *Blysmus compressus* was recorded for the first time. *D. fuchsii* and *D. maculata* were seen again, but the main feature of the site was the extensive population of *D. traunsteineri*. A large population of *Cirsium dissectum* was present in *Molinia* grassland adjacent to the fen, while dry ridges between the springs supported an unusual community which included *Calluna vulgaris*, *Carlina vulgaris*, *Salix repens* and *Antennaria dioica*.

In the afternoon, the third site, Haggs Wood Marsh, adjacent to Newtondale was visited. Here, both *Eriophorum latifolium* and *E. angustifolium* were noted while *Myrica gale*, *Menyanthes trifoliata*, *Serratula tinctoria* were all added to the list of species seen during the day. The main feature of this fen is however the spectacular show of *Trollius europaeus* which was in full bloom at the time of our visit.

Our thanks are due to the Forestry Commission, Mr R. Boyes and the Yorkshire Wildlife Trust for permitting us to visit their land.

P. J. Horton

NEW FOREST, HAMPSHIRE. 4TH AUGUST

This was a duplicate of the meeting held on 3rd September 1983 and which had been massively oversubscribed. 21 members took part. Although the meeting was held a month earlier and in a drought year, all the same plants were again recorded except for *Spiranthes spiralis*. *Hammarbya paludosa* was found in the same bog but about 50 m away from the 1983 plants. (See Watsonia, **15**: 297–298(1985)).

J. Ounsted

WALES

TINTERN, MONMOUTH. 1ST–3RD JUNE

A small group of nine members met for this residential weekend at the Nurtons Field Centre in the lovely wooded setting of the Lower Wye Valley. The object of the meeting was not to look for rare or unusual plants. Quite the reverse in fact, as it was to concentrate on our common 'weeds' and consider their relationship to modern vegetables, and in the evenings to sample their much neglected edibility. The site chosen for this was the 3 ha of organic market garden of the 12 ha holding. An area that has had no artificial sprays used on it in the last 20 years, this garden enjoys a diverse community of both common and less common wild plants, as well as a large range of cultivated vegetables. The regime of gardening allows all species a place to grow with and alongside the crops, and members were impressed with the obvious health and abundance of the crop plants. How many of our threatened species would grow freely if more farmland were like this? The herb garden also provides a home for some of our disappearing favourites such as Woad and Elecampane, as well as plants like Tansy, Sweet Cicely and Fennel.

At mealtimes we tasted the delights of classic dishes like Nettle soup garnished with Ramson flowers, and of almost forgotten country greens – Fat Hen, Hop shoots, Hogweed sprouts, Ground Elder and creamed Chickweed. A wild salad included White Dead Nettle, Yarrow, Salad Burnet, garlic mustard and Dandelion leaves, and a dessert of Strawberries was scattered with Elder flowers.

Several members had come from the east of England, so we included in the weekend outings to show something of this lovely area. Llywyn-y-celyn, a very compact calcareous marsh, was visited on Saturday. This site is a Gwent nature reserve, with a rich sedge flora including *Carex hostiana*. *Menyanthes trifoliata* and abundant *Valeriana dioica* were in flower, and fine *Aconitum napellus* was found alongside the boundary stream. Locally common along the Welsh Marches, this plant contains powerful alkaloids still used in equine and human medicine. On Sunday, the venue was the area of magnificent limestone crags and woodland at Black Cliff near Chepstow. These broad-leaved woodlands, still with some *Ulmus glabra* among Beech, Ash and Hazel, contain a high percentage of ancient woodland indicator species including *Paris quadrifolia* in great quantity, and *Cardamine impatiens* on ground disturbed by forestry work. It is possible to see *Convallaria majalis*, *Carex digitata* and *Melica nutans*, together with the elusive *Carex strigosa* nearby, and hybrids between *Polystichum aculeatum* and *P. setiferum*; and of course *Euphorbia serrulata*, the Tintern Spurge, was visited. The outing ended with a short visit to Poors Allotment on the edge of the Forest of Dean, a heathy area which shows a particularly clear geological division. A sudden transition from sandstone to limestone makes it possible to stand with one foot by *Carex binervis* and one by *C. montana*, and similarly with *Nardus stricta* and *Helianthemum nummularium*.

These outings were enjoyable, and of course did pay tribute to the botanical excellence of this part of the world, and to its spectacular scenery, but both leaders wished that the weekend could have been twice as long, so that the original subject of the relationship of common plants to man could have been worked on in more depth, and more practical experience of their medicinal, cosmetic and edible properties achieved. It would be very pleasing to both of us if we could take these subjects further with B.S.B.I. members in the future.

R. Fitzgerald & E. Wood

LLANARMON-YN-IAL, DENBIGHSHIRE/FLINTSHIRE. 16TH JUNE

We met at Coed Talon to look at a sheltered valley in which coal is close to the surface. There were no very rare plants, but different habitats were studied. The deciduous wood contained *Lamiastrum galeobdolon*, *Galium odoratum* and *Prunus padus*. Recently felled areas were colonized by *Luzula pilosa*, *Veronica officinalis* and *Trifolium medium*. In the marshy floor of the valley were *Carex acutiformis*, *Typha latifolia* and *Riccia fluitans* (an aquatic liverwort). The dry slopes yielded *Blackstonia perfoliata*, *Phleum pratense* subsp. *bertolonii* and *Carex* spp. (*C. ovalis*, *C. flacca*. *C. panicea*, *C. sylvatica*, *C. hirta*, and *C. demissa*). At lunchtime, some of the party visited the site at which *Senecio cambrensis* was first collected and saw plants in flower.

The afternoon was spent on meadow slopes with limestone outcrops near Eryrys. Numerous plants of *Coeloglossum viride* were found. Three *Alchemilla* spp. (*A. glabra*, *A. xanthochlora*, and *A. filicaulis* subsp. *vestita*) were growing together with *Poa subcaerulea* and *Geum rivale*. On the cliffs were *Viola hirta*, *Cotoneaster microphyllus*, *Rosa pimpinellifolia*, *Cystopteris fragilis*, *Saxifraga tridactylites* and *Scabiosa columbaria*.

We searched an upland meadow unsuccessfully for *Antennaria dioica* which had been seen some years before. However, we found many spikes of *Botrychium lunaria* and *Gymnadenia conopsea*, and *Polygala vulgaris* was abundant in pale and dark blue, pink and white forms.

17 people attended, including members from South Wales and Wolverhampton.

J. A. GREEN & G. WYNNE

SCOTLAND

CREAG MEAGHAIDH, INVERNESSHIRE. 14TH-15TH JULY

The annual joint meeting of the Alpine Section of the Botanical Society of Edinburgh and the Botanical Society of the British Isles attracted 23 people.

On the Saturday, we visited Coire Ardair, approaching by the path from Aberarder Farm. This good path passed through some nice birch wood and open undulating moorland. A fine stand of the three orchids *Pseudorchis albida*, *Gymnadenia conopsea* and *Dactylorhiza maculata* subsp. *ericetorum* was found close to the path.

The large east-facing corrie still held a considerable amount of snow in the gullies and with mist and occasional rain the impression of a wild and desolate place was obtained. A number of rare plants was found including *Gnaphalium norvegicum*, which was almost in flower although most plants were in a vegetative state. Flushes near the corrie contained *Juncus castaneus*, *J. triglumis* and *Carex saxatilis*. The Holly Fern, *Polystichum lonchitis* could be found with the Parsely Fern, *Cryptogramma crispa* as intimate ledge and crevice companions; this seemed unusual as they normally prefer quite different soils and rock types. *Athyrium distentifolium* was probably the most abundant fern. Other plants of note included *Carex vaginata*, *Cerastium alpinum*, *Coeloglossum viride*, *Galium boreale*, *Poa glauca*, *Saussurea alpina*, *Saxifraga aizoides*, *S. hypnoides*, *S. oppositifolia*, *Sibbaldia procumbens*, *Silene acaulis*, *S. dioica*, *Trollius europaeus* and *Veronica alpina*.

Moy Lodge was the meeting place on the Sunday and the party soon split in two, one group staying low, trying to locate an old record of *Paris quadrifolia*, but this they failed to find. They did however find *Hammarbya paludosa*, *Eriophorum latifolium*, *Drosera anglica* and a wide range of sedges in the bogs. Amongst birch scrub, rock outcrops and boulders they found *Avenula pratensis* and *Melica nutans*.

The second party walked up to Moy Coire finding *Cornus suecica*, *Parnassia palustris*, *Rubus chamaemorus* and some very free-flowering *Vaccinium uliginosum* on the moor. The Moy Coire is a big horseshoe of rocks and cliffs encircling quite a large lochan. The chief finds here included *Alopecurus alpinus*, *Carex atrata*, *Cerastium cerastoides*, *Epilobium alsinifolium*, *Juncus castaneus*, *J. triglumis*, *Phleum alpinum*, *Poa alpina*, *Polystichum lonchitis*, *Pyrola minor*, *Salix lapponum* and *Tofieldia pusilla*.

Alpine hawkweeds were much in evidence in both of the corries but no names are available.

R. J. D. MCBEATH

IRELAND

ST JOHN'S WOOD, ROSCOMMON. 19TH MAY

St John's Wood, on the western shore of Lough Ree, is one of the last native woods of any size in the Irish midlands today. It is listed as a site of International Importance by An Foras Forbatha (*Areas of Scientific Interest in Ireland*, 1981) – the only such site in Co. Roscommon. Ownership is divided between the Forest and Wildlife Service and a number of private owners. The wood is extensive (150 ha), and yet, apart from a few conifers and Sycamores in the western part, it is composed entirely of native species.

The day threatened rain; it fell intermittently, but not enough to deter us. The party was about 15, with an unusually wide range of ages; it was led by J. Early (county recorder) and D. L. Kelly. The junior members of the Northridge family proved adept at spotting *Lathraea squamaria*; several colonies were located. *Neottia nidus-avis*, *Ranunculus auricomus*, *Geum rivale* × *urbanum* and *Dryopteris carthusiana* were added to a list compiled from previous visits.

The major part of the wood is on shallow, well-drained soil over limestone. The woodland canopy is unusually diverse, with plentiful *Quercus robur*, *Fraxinus excelsior*, *Ulmus glabra*, *Corylus avellana* and *Ilex aquifolium*. A few *Taxus baccata* and *Prunus avium* were found, and some fine trees of *Sorbus hibernica*. Sadly, there was much evidence of recent felling, especially of oak, so that parts of the wood have been reduced to scrub. An area of several hectares had recently been clear-felled. We made our way down to the rocky lakeshore, where we peered inconclusively at *Salix*. Trying to get back to our cars, we found ourselves wandering in a real-life 'Babes in the Wood'. I draw two morals: a) this is a wood to be prized – one of the very few native woods left in Ireland that is large enough to get lost in; b) be wary of getting separated from your lunch!

After our hard-earned repast, we proceeded to the adjacent wetland alongside Blackbrink Bay. The fen flora included such characteristic midlands species as *Cicuta virosa*, *Berula erecta*, *Ranunculus lingua* and *Thalictrum flavum*. Pin-eyed and thrum-eyed *Menyanthes trifoliata* were admired (a trick not confined to *Primula*). The area was a complex of cut-away peats, with a series of different mire types. Higher peaty ground supported *Osmunda regalis*, *Prunus padus* and *Frangula alnus*. Crossing back into the adjacent part of St John's Wood, we found a remarkable swamp woodland community with *F. alnus* abundant in the understorey, accompanied by *Rhamnus catharticus* and *Prunus padus*. *F. alnus* is rare in Ireland, but Tansley noted that the two buckthorns may dominate young fen carr in East Anglia.

We left convinced that this is a very remarkable wood, deserving the highest priority for active conservation; letters to this effect have been sent to the Chairman of Roscommon County Council and to the Minister of Fisheries and Forestry.

D. L. KELLY

FRANCE

NORMANDY. 3RD–10TH JULY

Some 20 members attended this meeting in the part of France which most resembles southern England in both flora and scenery, in beautiful sunny weather throughout the week. On 3rd July the party crossed the Straits of Dover from Folkestone to Boulogne, and drove south to Rouen, where we were to stay the first three nights. The opportunity was taken to spend some hours en route in examining two of the magnificent and extensive calcareous fens near the coast of the Pas-de-Calais at Cucq (Marais de Villiers) and at Merlimont (Marais de Balançon). These fens, among the best left in western Europe, produced good colonies of *Liparis loeselii* (the large East Anglian variant) and also *Eriophorum gracile*, *Carex diandra*, *C. lasiocarpa*, *C. lepidocarpa*, *C. elata*, *Schoenus nigricans*, *Cladium mariscus*, *Ranunculus lingua*, *Pedicularis palustris*, *Utricularia australis*, *Orchis laxiflora* subsp. *palustris* (unknown in the British Isles), *Dactylorhiza traunsteineri*, *D. praetermissa*, and *D. incarnata* subsp. *ochroleuca* and subsp. *pulchella*, besides the type; this list however is merely a selection of the most interesting species seen in these fens.

On 4th July, we travelled south from Rouen to study the famous chalk slopes and cliffs of the gorge of the River Seine near Orival. Among the enormous number of chalk grassland species seen were many not known in the British Isles as natives, such as *Gymnadenia odoratissima*, *Stachys recta*, *Teucrium montanum*, *Globularia punctata*, *Digitalis lutea*, *Vincetoxicum hirundinaria*, *Bupleurum falcatum*, *Linum tenuifolium*, *Euphorbia seguierana*, *Amelanchier ovalis*, *Prunus mahaleb*, and *Koeleria pyramidata*. These species were seen repeatedly in other similar sites. They have got as far as Normandy, but have, for reasons not always clear, been unable to establish themselves on our side of the Channel; presumably these steep south-facing chalk slopes are just a little warmer than any sites we possess. In addition, many rare British calcicole species occurred, mostly in abundance, such as *Pulsatilla vulgaris*, *Phyteuma tenerum*, *Helianthemum apenninum*, *Carex humilis*, *Seseli libanotis*, *Geranium sanguineum*, *Teucrium chamaedrys*, *Orobanche caryophyllacea*, *Himantoglossum hircinum*, *Ophrys fuciflora*, and *Epipactis atrorubens*, among dominant *Sesleria albicans*. *Orobanche* species such as *O. gracilis* and *O. teucrii* also excited admiration. Other nearby chalk cliffs and screes, at the Roche St Adrien, added *Viola hispida*, a beautiful Norman endemic, and *Helianthemum canum*. The chalk downs of the Eure valley further south had a similar flora, with the addition of *Fumana procumbens*, *Astragalus monspessulanus* (at the extreme northern limit for this largely Mediterranean species), *Coronilla minima*, *Anthericum ramosum*, *Ononis natrix*, and *O. pusilla*, besides the more familiar *Rubia peregrina*, and *Orchis purpurea* (in fruit). The Forêt de Bray on the Lower Greensand yielded a bog rich in *Vaccinium oxycoccos*, and the Forêt d'Eu, again on chalk, had *Epipactis leptochila* and *Hordelymus europaeus* in beech forest, besides *Herminium monorchis* and much else that occurs on our southern chalk downs.

On 6th July we drove west to Carteret in the Cotentin peninsula by Bayeux (where the famous Tapestry was inspected) to a very different type of country on ancient, acidic rocks, more like Devonshire. The sand dunes here produced *Bupleurum baldense*, and *Limonium auriculae-ursifolium* and *Frankenia laevis* on the saltmarsh edge; the more extensive dunes at Vauville to the north were bright in places with *Veronica spicata* among *Thesium humifusum*, while the slacks had *Mentha pulegium*, *Teucrium scordium*, *Parentucellia viscosa*, *Carex punctata* and *Cyperus longus*, but some species were very scorched by the drought.

The coastline east of Cherbourg produced *Otanthus maritimus*, *Lagurus ovatus*, *Euphorbia peplis*, *Orobanche purpurea*, *Polycarpon tetraphyllum* and Natterjack toads, besides much *Eryngium maritimum* and *E. campestre* with *Orobanche amethystea* as their parasite. West of Cherbourg, *Centaurium scilloides* was locally plentiful on the cliffs. Inland, a rocky oakwood at Mesnil-au-Val had much *Hymenophyllum tunbrigense*, *Dryopteris aemula*, *Sibthorpia europaea*, and *Wahlenbergia hederacea* on rocks and in flushes.

Perhaps the highlight of the week for many people, however, was the wet heathland south of the fine Norman Abbey of Lessay, where *Spiranthes aestivalis* still occurs as about 600–700 individuals in perhaps its finest remaining European site, together with *Rhynchospora fusca*, *Lobelia urens*, *Carum verticillatum*, *Galium debile*, and *Deschampsia setacea*. Nearby, *Gentiana pneumonanthe* (not in flower) and bogs with all three *Drosera* species and *Narthecium ossifragum* were seen in a Nature Reserve at La Tourbière de Mathon.

On our last day we visited the great cliffs of Cap de Flamanville, where *Inula crithmoides*, *Asplenium billotii* and *Limonium binervosum* were seen, but *Lotus subbiflorus* and *Juncus capitatus*, known here previously, seemed to have failed this summer due to drought.

Those who attended this excursion were left with the realization that though our own flora is very interesting, it is only a pale shadow of the richness of that on the European continent, even as near as Normandy.

F. Rose

SWITZERLAND

LAUTERBRUNNEN. 25TH JUNE–2ND JULY

13 members assembled at Gatwick Airport for the flight to Zürich, whence transfer to Lauterbrunnen was made by rail via Bern and Interlaken. The party was based in self-catering chalet accommodation just outside Lauterbrunnen, which lies about 12 km due south of Interlaken in the heart of the Bernese Oberland. During the week, six highly successful field excursions were made, each followed by lively evening identification and discussion sessions.

On the first morning the party travelled by rail through the awe-inspiring scenery of the Lauterbrunnental up to Wengen and on to Kleine Scheidegg (2061m) for a walk through Alpiglen to Grindelwald. Above us towered the lofty peaks of the Jungfrau (4158m), Mönch (4099m) and the Eiger (3970m). After poor spring weather in the Alps, the season was fully three to four weeks retarded and much more snow than is usual in late June lingered on in the vicinity of Kleine Scheidegg, providing a fine opportunity to see *Soldanella alpina* and *Crocus vernus* subsp. *albiflorus*, which flower as soon as the snow recedes (and often beneath it). *Ranunculus aconitifolius* formed large white areas on the mountainsides and *Caltha palustris* vividly marked the water courses. Within a few hundred metres of the village many members of our own impoverished alpine flora were encountered, often in huge quantity, and on a well-worn pathside several plants of the tiny *Gagea fistulosa* were located. On acid formations *Gentiana acaulis*, *Homogyne alpina*, *Potentilla aurea*, *Bartsia alpina*, yellow-flowered *Pulsatilla alpina* subsp. *apiifolia*, *Trifolium alpinum*, *Luzula lutea* and *Loiseleuria procumbens* were noted, with *Gentiana verna*, white-flowered *Pulsatilla alpina* subsp. *alpina*, *Silene acaulis*, *Androsace chamaejasme*, *Viola calcarata*, *Primula farinosa* and *Plantago atrata* on the outcropping limestone. The party progressed slowly down through Alpiglen with numerous stops being made as members familiarized themselves with the rich flora. *Ranunculus alpestris*, *Globularia nudicaulis*, *Hutchinsia alpina* and *Tofieldia calyculata* adorned a stream-side; nearby *Oxytropis jacquinii*, *Kernera saxatilis*, *Sedum atratum* and *Biscutella laevigata* were growing on bare stony ground with much *Primula auricula* on limestone. Fine specimens of *Cystopteris montana*, *Polystichum lonchitis* and *Gymnocarpium robertianum* abounded on the rock-strewn slopes. Richard Thomas, the party's sedge expert, pointed out *Carex rupestris* growing with *Arctostaphylos alpinus*; *C. firma*, *C. ferruginea* and *C. sempervirens* were noted here (and throughout the week) but *C. davalliana* was found only on this day. A small patch of the very local *Moehringia ciliata* beside the track was accompanied by tiny *Veronica aphylla*. The wooded slopes of lower altitudes were rich in *Moneses uniflora*, *Actaea spicata*, *Maianthemum bifolium*, *Streptopus amplexifolius* and sedges *Carex digitata* and *C. ornithopoda*.

The second morning took us to the summit of Schilthorn (2970m), widely known as the location for the James Bond film "On Her Majesty's Secret Service". Despite the lateness of the season, *Ranunculus glacialis* was flowering well on crumbling rock surfaces, as were *Saxifraga oppositifolia* and dense clumps of *Androsace alpina* and *A. helvetica*. Unfortunately, *Geum reptans* and *Artemisia genipi* were yet to open. Few plant species are able to withstand the harsh conditions at these altitudes and, not surprisingly, plant cover is probably as low as 5%. The considerably reduced atmospheric pressure soon took its toll – the party becoming notably sluggish. Extensive late snow fields made the planned descent through the Blumental to Mürren impossible, return to Mürren by cable car followed by a leisurely walk down to Lauterbrunnen being substituted. *Acinos alpinus* (in Mürren itself) and *Veronica fruticans* provided some compensation, however, and the railway line to Grütschalp proved a fine hunting ground with *Erinus alpinus* a notable feature. *Rhododendron ferrugineum* was admired and photographed before the very steep descent to base was undertaken. *Cicerbita alpina*, *Stachys alpina* and *Lilium martagon* were disappointingly only in bud but a wealth of *Polygonatum verticillatum*, *Stellaria nemorum* and *Saxifraga rotundifolia* was in flower.

A link-up with Mary Briggs' Cox and King party on the next day preceded a coach drive to Kandersteg for a leisurely perambulation of the unforgettable Gasterental. Led by Max Seiler, of the Basle Natural History Society, the excursion was of exceptional botanical interest and, moreover, after just half an hour's steep climb, traversed almost level ground throughout the day! Although only about 30 km west of the Lauterbrunnental, this beautiful valley supports a somewhat different flora with *Clematis alpina* (scrambling over juniper), *Amelanchier ovalis*, *Aquilegia alpina* and *Cypripedium calceolus* forming the highlights. Limestone scree yielded the umbellifer *Athamanta cretensis*, *Dryas octopetala*, abundant *Moehringia muscosa*, a wealth of ferns and local *Senecio doronicum*; in wet meadows, *Pedicularis verticillata* and *Pseudorchis albida* abounded together with occasional plants of striking *Pedicularis foliosa*.

The lure of glaciers drew us to Obergletscher and its environs on the Thursday, reached by train to Grindelwald and a 45-minute walk. The air temperature close to the glacier was considerably depressed and, as a result, the vegetation was much retarded. Most noticeable here were *Epilobium fleischeri*, its extensive roots binding moraine, and *Gypsophila repens* flowering on bare glacial debris. Dense coniferous woodland supported fine colonies of *Moneses uniflora*, *Corallorhiza trifida* and *Orthilia secunda* together with abundant *Bellis sylvestris*. Away from the glacier, river shingle was, as always, a botanical paradise with a great many plants brought down from higher altitudes; with *Arabis alpina*, *Linaria alpina*, *Aconitum napellus*, *Epilobium collinum*, and grasses including *Phleum alpinum* and *Poa alpina* were *Salix daphnoides*, *S. helvetica*, *Ribes petraeum* and much more besides. *Carex flava* and *C. capillaris* were noted amongst many interesting species, including *Arabis glabra*, growing on the banks of a small stream, and adjoining coniferous woodland had *Listera cordata* and several small populations of *Cypripedium calceolus*. With the latter was *Luzula luzulina*, at first mistaken for *L. forsteri* which it much resembles. This area has a very rich flora and is highly recommended, especially to those unable to climb. On the return from Grindelwald, some members could not resist a look at a railway siding at Zweilütschinen during a wait for a connection: here, on ballast, was a large colony of *Astragalus alpinus* in flower and fruit, with *Bromus inermis* and *Calamagrostis varia*.

The fifth day, spent entirely in the Lauterbrunnental, proved to be the best of the week weatherwise. The post-bus was taken to Stechelberg and the party walked leisurely back to Lauterbrunnen. During a brief stop at the cable-car station, a tuft of *Saxifraga cespitosa* was spotted on the river gravel ballast covering the long-term car park. Within a short while, upwards of 20 species of alpines, largely in flower, had been located and identified; these included *Campanula cochlearifolia*, *Dianthus sylvestris*, *Erigeron glabratus*, *Artemisia genipi*, *A. umbelliformis*, *Agrostis alpina*, *Globularia cordifolia*, *Verbascum lychnitis* (the yellow-flowered form) and *Leontopodium alpinum*, the last flowering some two months earlier than usual. A remarkable assemblage of introductions indeed and at the low altitude of 868m! The walk continued along the river and through adjacent broad-leaved woodland where *Cardamine pentaphyllos* in fruit, *Senecio nemorensis*, *Aconitum vulparia*, *Peucedanum ostruthium*, *Aruncus dioicus* and *Impatiens noli-tangere* were recorded. A picnic lunch was followed by a visit to the Trümmelbach Falls, the most spectacular underground waterfalls in Europe. On the rocks outside were *Luzula nivea*, *Laserpitium siler* and *Valeriana montana*. Nowhere can the richness of sub-alpine meadows be more striking than in this valley – nor provide a starker contrast with our own 'monocultures'. After a short break, we continued beyond Lauterbrunnen to explore a *Cephalanthera rubra* site near the falls on the Isenfluh road; here also were *Epipactis atrorubens*, *Digitalis lutea*, *D. grandiflora*, *Teucrium montanum* and *Saxifraga paniculata*.

The next day saw an early departure for the Jungfraujoch. The party split at Eigergletscher station (2320m), some continuing to the observatory above and others alighting to botanize. Reunited at noon, we explored the ridges above Eigergletscher where *Lloydia serotina*, *Draba aizoides*, *Saxifraga moschata*, *Trifolium thalii*, *Hedysarum hedysaroides*, *Bupleurum stellatum* and diminutive *Antennaria carpatica* were in flower on alkaline soils, with *Primula hirsuta* and *Omalotheca supina* on acid substrates. On moraine *Doronicum grandiflorum*, *Achillea atrata*, *Cirsium spinosissimum*, *Galium helveticum* and *Linaria alpina*, in a variety of colour forms, were noted. Towards Kleine Scheidegg the early flowers of the meadows were at their best with *Pulsatilla vernalis*, *Anemone narcissiflora*, *Minuartia verna*, *Carex firma*, *Gentiana verna*, *G. brachyphylla*, *G. clusii* (including a white-flowered form), abundant *Primula auricula* and *P. farinosa*. Several scarlet and other variously coloured primulas probably represented hybrids between *P. auricula* and *P. hirsuta*. Ibex (*Capra hirca*) grazing these slopes were not in the least shy and were much photographed. The walk ended at Wengernalp after a concerted, and eventually successful, search for *Gentiana bavarica*, the least common of the three local members of the *G. verna* group.

On the last day, prior to the homeward journey, members went their separate ways. Two further finds of note were *Tolpis staticifolia* and *Anthericum ramosum*, both on limestone scree near the village.

This account would not be complete without thanks to Messrs Milton's Travel of Bristol and the proprietors of 'Camping Jungfrau', the family von Allmen-Jossi, for their assistance with travel arrangements; and to Messrs A. O. Chater, R. W. David and E. J. Clement for taxonomic assistance.

A. L. GRENFELL

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The genus *Cicerbita* Wallr. in the British Isles

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ABSTRACT

Four species of *Cicerbita* Wallr., the native *C. alpina* (L.) Wallr. and the introduced *C. macrophylla* (Willd.) Wallr. subsp. *uralensis* (Rouy) P. D. Sell, *C. plumieri* (L.) Kirschleger and *C. bourgaei* (Boiss.) Beauverd, are recorded in the British Isles. A key to the species, citation of nomenclature, descriptions and an account of their distributions are given.

INTRODUCTION

The genus *Cicerbita* Wallr. belongs to the family Asteraceae (Compositae) subfamily Lactucoideae tribe Lactuceae. It consists of about 18 species native to the mountains of Europe, Asia, North Africa and North America. They are perennial, rhizomatous or tap-rooted herbs with erect stems, alternate, deeply divided leaves with a semiamplexicaul or more or less auriculate base and an inflorescence of bluish, rarely yellow, 5–30-flowered capitula. The involucral bracts are in three or more series and the achenes are linear or elliptic with a pappus of two rows of hairs, the outer ring consisting of very short, smooth hairs and the inner ring of long, scabrous hairs.

In the character of the pappus, *Cicerbita* is closely allied to *Mycelis* Cass., *Cephalorrhynchus* Boiss. and *Steptorhamphus* Bunge. *Mycelis* is distinguished by its fewer involucral bracts, which are in two series, the outer very inconspicuous, and by its yellow flowers. *Cephalorrhynchus* and *Steptorhamphus* are distinguished by the long beak to the achene. In *Cicerbita* the beak is absent or not more than 0·5 mm. The large genus *Lactuca* L., in which all these small genera including *Cicerbita* were once included, is distinguished by its pappus hairs all being of one kind and more or less equal in length.

Only one species, *C. alpina* (L.) Wallr., is native in the British Isles, but three others, *C. macrophylla* (Willd.) Wallr. subsp. *uralensis* (Rouy) P. D. Sell, *C. plumieri* (L.) Kirschleger and *C. bourgaei* (Boiss.) Beauverd, have been recorded as naturalized.

KEY TO SPECIES

1.	Plant glabrous	3. *C. plumieri*
1.	Peduncles and/or upper part of stem with glandular or simple hairs	2.
2.	Stems and sometimes peduncles with rather rigid simple hairs, without glandular hairs	4. *C. bourgaei*
2.	At least the peduncles and usually also the upper part of the stem and involucre glandular-hairy	3.
3.	Lower leaves glabrous, with a triangular terminal lobe and few pairs of small lateral lobes; capitula in an elongated panicle; achenes linear	1. *C. alpina*
3.	Lower leaves hairy on veins beneath, with a cordate terminal lobe and usually only a single pair of lateral lobes; panicle wider, more or less corymbose; achenes narrowly elliptical	2. *C. macrophylla*

ACCOUNT OF SPECIES

1. *C. ALPINA* (L.) Wallr., *Sched. Crit.* 434 (1822).
Sonchus alpinus L., *Sp. Pl.* 794 (1753).
Mulgedium alpinum (L.) Less., *Syn. Gen. Comp.* 142 (1832).
Sonchus caeruleus Sm., *Fl. Brit.*, **2**: 815 (1800) nom. illegit. superfl. pro *Soncho alpino* L.
Lactuca alpina (L.) A. Gray, *Syn. Fl. N. Amer.*, **1(2)**: 444 (1884).

Vernacular Name: Alpine Blue Sow-thistle
Illustrations: Ross-Craig, *Drawings Brit. Pl.*, **18**: pl. 35 (1963). Streeter, *Wild Fl. Brit. Is.* 186, pl. 88 (1983).

Stem 50–250 cm, simple or branched, usually with dense, reddish glandular hairs on the upper part. Leaves 8–25 × 2–12 cm, glabrous, glaucous beneath; lowest lyrate or runcinate-pinnatifid with a large, broadly triangular, acuminate terminal lobe and a few pairs of much smaller triangular lateral ones, with the base narrowed into a winged petiole; upper smaller and less divided, with a winged petiole widened into a cordate-amplexicaul base. Capitula in an elongated panicle; peduncles with dense reddish glandular hairs. Involucre 10–15 × 7–10 mm; bracts linear, usually with numerous reddish glandular hairs. Ligules pale blue. Achenes 4.5–5 mm, linear.

C. alpina is a very rare plant in the British Isles, being confined to remote gullies and cliff ledges in the mountains of Angus (v.c. 90) and Aberdeen (v.c. 92). Its past and present distribution, habitat and general ecology and conservation are discussed in detail in the following paper in this journal by Marren *et al.* (1986). In continental Europe it is locally abundant in Fennoscandia and the mountains southwards to the Pyrenees, northern Apennini and Bulgaria.

2. *C. MACROPHYLLA* (Willd.) Wallr., *Sched. Crit.* 434 (1822).
Sonchus canadensis Froelich in *Ann. Bot.* (*Usteri*), **1**: 29 (1791), non L., *Sp. Pl.* 793 (1753).
Sonchus macrophylla Willd. in L., *Sp. Pl.*, 4th ed., **3(3)**: 1519 (1803).
Mulgedium macrophyllum (Willd.) DC., *Prodr.*, **7(1)**: 248 (1838).
Lactuca macrophylla (Willd.) A. Gray, *Syn. Fl. N. Amer.*, **1(2)**: 444 (1844).

subsp. *URALENSIS* (Rouy) P. D. Sell in *Bot. J. Linn. Soc.*, **71**: 249 (1976).
Sonchus hispidus Ledeb., *Fl. Altaica*, **4**: 140 (1833), non Gilib., *Fl. Lithuan.*, **1**: 241 (1781) non rite publ., non *C. hispida* (Bieb.) Beauverd in *Bull. Soc. Bot. Genèv.* sér. 2, **2**: 141 (1910).
Mulgedium hispidum (Ledeb.) DC., *Prodr.*, **7(1)**: 250 (1838).
Mulgedium macrophyllum var. *hispidum* (Ledeb.) Korsh in *Mem. Acad. Sci. Petersb. (Sci. Phys. Math.)* ser. 8, **1**: 265 (1898).
Mulgedium uralensis Rouy, *Ill. Pl. Eur. Rar.*, **16**: 128, t. cccxc (1901).
C. uralensis (Rouy) Beauverd in *Bull. Soc. Bot. Genèv.* ser. 2, **2**: 123 (1910).
C. gmelinii Beauverd in *Bull. Soc. Bot. Genèv.* ser. 2, **2**: 123 (1910) nom. nov. pro *Soncho hispido* Ledeb., non *C. hispida* (Bieb.) Beauverd in *Bull. Soc. Bot. Genèv.* sér. 2, **2**: 141 (1910).

Vernacular Name: Common Blue Sow-thistle
Illustration: Fig. 1.

Perennial with pale brown fibrous roots and long whitish rhizomes which send up flowering stems at regular intervals. Stems 60–200 cm, pale green, rather slender, slightly angular, glabrous below with an occasional very long, slender glandular hair in upper part. Leaves up to twelve, all cauline with up to three sometimes close together near the base, becoming gradually smaller up the stem, rather dull yellowish-green, glabrous or nearly so on upper surface, slightly glaucous with prominent venation on lower surface and with numerous simple eglandular hairs on the veins; lowest 6–20 (–40) × 5–17 (–21) cm, ovate, rounded-obtuse to subacute at apex, sinuate-glandular-denticulate, more or less cordate at base, the petiole 10–30 cm with a denticulate, irregular wing for most or all of its length, sometimes tinted purplish at base and with pale simple eglandular hairs; medium and

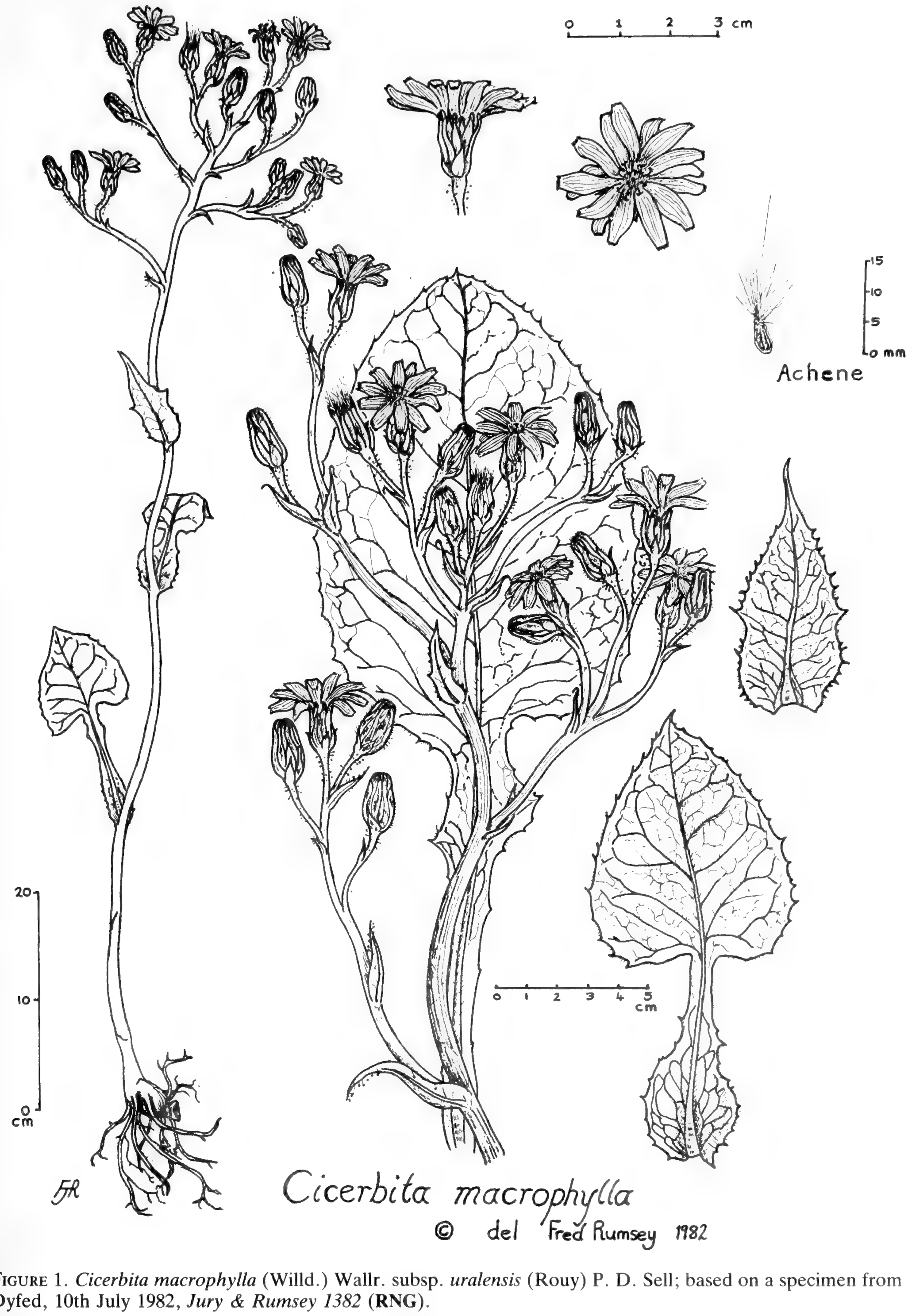

FIGURE 1. *Cicerbita macrophylla* (Willd.) Wallr. subsp. *uralensis* (Rouy) P. D. Sell; based on a specimen from Dyfed, 10th July 1982, *Jury & Rumsey 1382* (**RNG**).

lower 16–30 × 8–12 cm, lyrate, the terminal lobe 12–16 × 8–12 cm, ovate, shortly acute or acuminate at apex, sinuate-glandular-denticulate, often cordate at base, the midrib between lateral and terminal lobes broadly winged with occasional small teeth, the basal lobes forming a subrotund outline with a cordate-amplexicaul base; upper 6–14 × 1·5–6 cm, lanceolate to narrowly ovate, long-acuminate at apex, sinuate-glandular-denticulate, rounded amplexicaul at base. Inflorescence with a compact group of capitula near the apex and several long branches up to 16 cm from the upper leaf axils. Capitula 40–50 mm in diameter; peduncles 3–25 mm, slender, with numerous, yellowish glandular hairs. Involucre 8–15 × 4–9 mm, narrowly cylindrical; bracts 4·5–14 × 1·5–2 mm, pale yellowish-green with a very narrow pale margin and slightly purplish at apex, linear or linear-lanceolate, more or less obtuse at apex, with numerous yellowish or slightly reddish glandular hairs. Flowers 27–33; ligules 15–23 × 3–4 mm, pale lilac with slightly darker veins, shallowly and irregularly dentate at apex. Stigmas pale lilac-blue. Receptacle shallowly pitted. Achenes c. 5 mm, elliptical, flattened, narrowly winged, with 3 ribs on each face, glabrous.

As the only description of this species of any length is in Russian and as I have living material as well as herbarium sheets available to me, I have taken the opportunity of giving a more detailed account than for other species.

When preparing the account of *Cicerbita* for *Flora Europaea* (Sell 1976), I borrowed the numerous specimens of *C. macrophylla* from the Leningrad (**LE**) herbarium and found they were divisible into two subspecies. Plants from the Caucasus, subsp. *macrophylla*, had the main branches of the panicle 2·5–3·5 (−5) mm in diameter and the ligules dark violet while those from the Urals, subsp. *uralensis*, had the main branches of the panicle 1·5–2·5 (−3) mm in diameter and the ligules pale lilac. All the British naturalized material I have seen is referable to subsp. *uralensis*. There is no record of when this plant was first introduced into British gardens. D. E. Allen informs me there is a letter in the G. C. Druce correspondence at Oxford, from C. Bucknall dated 15th May 1918, in which he states he found *Mulgedium macrophyllum* naturalized by the roadside at Glenridding, Ullswater in August 1915. It was recorded as a naturalized escape in a field next to a house, Kingsland, parish of Meole, Shropshire, v.c. 40, in July 1921 by Agatha Wilkinson. The specimen in herb. Oxford (**OXF**) contains a note by Mr Oliver (the owner of the house) to say he had seen it there for 30 years. These records were followed by one from Patterdale, v.c. 69, in 1922 by W. W. Mason and another by the same author from Melmerby, v.c. 70, in 1923. It has since been recorded from most areas of Great Britain and has even reached the west of Ireland (Fig. 2) (Akeroyd *et al.* 1983). The same subspecies seems to be widely naturalized in continental Europe.

In 1972 U. K. Duncan sent me plants from the grounds of Colliston Castle, near Arbroath, Angus, v.c. 90, which I grew in my garden. Since then they have spread profusely over several square metres but have not travelled any distance. Most naturalized colonies seem to be of this size, although some spread over larger areas. It is likely that the species reaches a new area by rhizomes thrown out from gardens, or rhizomes transported in piles of earth, and if the terrain is at all suitable soon forms a clonal patch by rhizomatous spread. I have not seen viable seed produced in this country and it is possible that each colony is a clone and the species is self-incompatible. Moreover we do not know how many different introductions have been made to the country as a whole. The flowers, which are open throughout the day from late June to August, are visited by *Bombus* spp. and various Diptera.

3. *C. PLUMIERI* (L.) Kirschleger, *Fl. Alsace*, **1**: 401 (1852).
Sonchus plumieri L., *Syst. Nat.*, 10th ed., **2**: 1192 (1759).
Mulgedium plumieri (L.) DC., *Prodr.*, **7(1)**: 248 (1838).
Lactuca plumieri (L.) Gren. & Godron, *Fl. Fr.*, **2**: 322 (1851).

Vernacular Name: Hairless Blue Sow-thistle
Illustration: Fig. 3.

Plant glabrous. Stems 60–130 cm. Leaves 5–60 × 2–17 cm, lyrate-pinnatifid with a large triangular terminal lobe and several pairs of more or less ovate lateral ones which are shorter than, but at least as wide as, the terminal; lobes more or less undulate, with mammiform teeth; midrib between lobes and petiole with a broad wing. Capitula in a wide, more or less corymbose panicle. Involucre

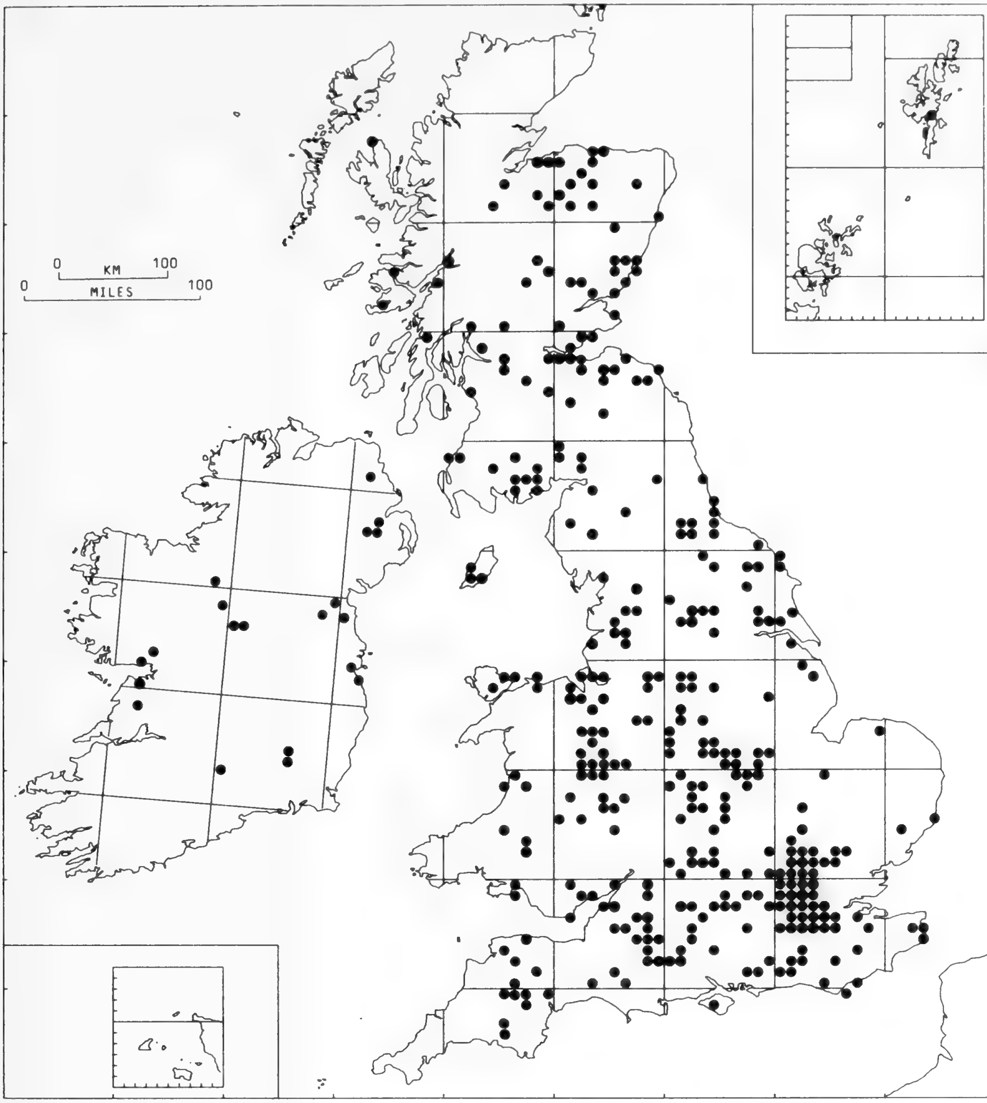

FIGURE 2. The distribution of *Cicerbita macrophylla* subsp. *uralensis* in the British Isles.

10–17 × 9–12 mm; bracts lanceolate or linear-lanceolate. Ligules blue. Achenes 5·5–6·5 mm, flat, linear to narrowly elliptical, conspicuously narrowed at apex.

Clapham (1962) stated that *C. plumieri* is often cultivated and sometimes escapes. I have been able to trace the following records. The only specimen I have seen is the McCallum Webster one from Tighnabruich.

v.c. 2, E. Cornwall. Saltash, c. 1975, *E. Griffiths*. Margetts & David, *Rev. Cornish Fl.* 370 (1981).

v.c. 4, N. Devon. Hedgerow near gardens, off Orchard Hill, Bideford, 11th July 1956, det. W. Keble Martin.

v.c. 14, E. Sussex. Warren Wood, Borde Hill, near Haywards Heath, 13th Sept. 1982, *K. E. Bull*, det. E. J. Clements.

FIGURE 3. *Cicerbita plumieri* (L.) Kirchleger; based on a specimen from Spain, 1st August 1982, *Goyder & Jury 213* (**RNG**).

v.c. 32, Northants. Fletton brickyards, 1945, Herb. Oundle School Natural History Society. J. S. Rees, *A Flora of Oundle* 131 (1969) (as *Lactuca plumieri*).
v.c. 59, S. Lancs. Preston neighbourhood, F. W. Stansfield. *Gard. Chron.* (1917). Sand-dunes, Freshfield, 1960, *Mrs F. W. Holder*. J. P. Savidge, *Travis's Fl. S. Lanc.* 346 (1963).
v.c. 76, Renfrews. Near Paisley. *Proc. bot. Soc. Br. Isl.*, **1**: 173 (1954).
v.c. 77, Lanarks. Tollcross. *Proc. bot. Soc. Br. Isl.*, **1**: 173 (1954).
v.c. 96, Easterness. Garden escape at Tighnabruich near Invermoriston, 1950 and 24th June 1975 (**E**). M. McCallum Webster, *Fl. Moray, Nairn & E. Inverness* 372 (1978).
v.c. 99, Dunbarton. Milngavie. *Glasgow Nat.*, **17**: 76 (1953); *Proc. bot. Soc. Br. Isl.*, **1**: 173 (1954).
v.c. H39, Co. Antrim. By railway arch at Lambeg, and near Drum Bridge, escapes from garden of public-house at Drumbeg, where it was introduced about 1905, *E. N. Carrothers*. Stewart & Corry, *Fl. N.E. Ireland*, 2nd ed., 311 (1938) (as *Lactuca plumieri*).

C. plumieri is a native of the Pyrenees, the mountains of France and western-central Europe and south-western Bulgaria. There seem to be no records of when it was introduced to British gardens.

4. *C. BOURGAEI* (Boiss.) Beauverd in *Bull. Soc. Bot. Genèv.* sér. 2, **2**: 118 (1910).
Mulgedium bourgaei Boiss., *Fl. Or.*, **3**: 801 (1875).
Lactuca bourgaei (Boiss.) Irish & Taylor in L. H. Bailey, *Standard Cycl. Hort.* 1766 (1916).

Vernacular Name: Pontic Blue Sow-thistle.
Illustration: Fig. 4.

Robust perennial up to 300 cm with stout roots and many stems from one base. Stems erect, pale green, slightly ridged, solid, with scattered pale simple eglandular hairs. Leaves 40–70, 8–26 × 2–7 cm, all cauline, lower soon dying off, gradually decreasing in size up the stem, yellowish-green, thick, obovate or oblanceolate in outline, acute at apex, lower with a large terminal lobe and 1–2 pairs of small lateral ones, upper undivided, all shallowly and sharply dentate, narrowed to a semiamplexicaul base, glabrous above, with numerous stiff white eglandular hairs beneath, particularly on the prominent veins. Inflorescence long and narrow with up to 100 capitula, leafy in the lower part; peduncles glabrous or with short simple pubescence. Involucre narrow and cylindrical; bracts 1–12 × 1·7–2 mm, ovate-lanceolate to linear, obtuse at apex, pale green suffused purple, glabrous. Ligules pale lilac with darker veins and a nearly white base. Stigmas pale lilac. Achenes 4–4·5 mm, pale brown, many-ribbed.

I have traced the following localities for *C. bourgaei* as a naturalized British plant. There seems to be no record of when it was first introduced to British gardens. The first record of it naturalized is a specimen in **CGE** from Maldon in Essex in July 1950. It seems to be on the increase.
v.c. 7, N. Wilts. Kington Langley, near Chippenham, 1974, *G. M. Kay* and *Mrs J. Swanborough*. Little Sodbury, Aug. 1978, *Mrs E. Norman*.
v.c. 17, Surrey. Warlingham, top of Bug Hill, a long established escape, 1958, *S. Fletcher* (**BM**). 1963, *D. P. Young*. Lousley, *Fl. Surrey* 327 (1976). Burton, *Fl. London Area* 161 (1983).
v.c. 18, S. Essex. Near Woodham Mortimer Place, roadside hedge, 1953, *Miss G. Sparrow 1956–7*. Jermyn, *Fl. Essex* 162 (1974). Roadside, Maldon, 18th July 1950, *O. Folkard* (**CGE**).
v.c. 22, Berks. Boars Hill, 1963 and Whiteknights Park, 1965. Bowen, *Fl. Berks.* 264 (1968), as *Lactuca bourgaei*. Poughley, Aug. 1968, *H. J. M. Bowen* (**RNG**).
v.c. 24, Bucks. Lower Winchcombe Priory, near Thame, 10th July 1959, *J. F. May* (**RNG**). Naturalized by lane, Nether Winchendon, 12th Aug. 1968, *J. G. & C. M. Dony*.
v.c. 28, W. Norfolk. Roadside near a ford, Great Walsingham, 1st Aug. 1969, *J. R. Palmer*. Swann, *Suppl. Fl. Norfolk* 73 (1975).
v.c. 34, W. Gloucs. Little Sodbury, Avon, naturalized on roadside, 1977, *A. L. Grenfell & Mrs M. M. C. Reiss*. Westbury-on-Trym, Bristol, Avon, 1974, *C. H. Cummins*.
v.c. 64, Mid-W. Yorks. Pool, Otley, 4th Aug. 1947, *R. P. Libbey* (**RNG**).
v.c. 71, Man. Dumped rubble, Lezayre Curraghs, G.R. 24/4.9, 1984, *Miss M. Devereau* via D. E. Allen.
v.c. 80, Roxburghs. Roadside verge, above Sprouston Burn, Newtown St Boswells, 2nd Aug. 1983, *Miss J. Blance* (**herb. R. W. M. Corner**).

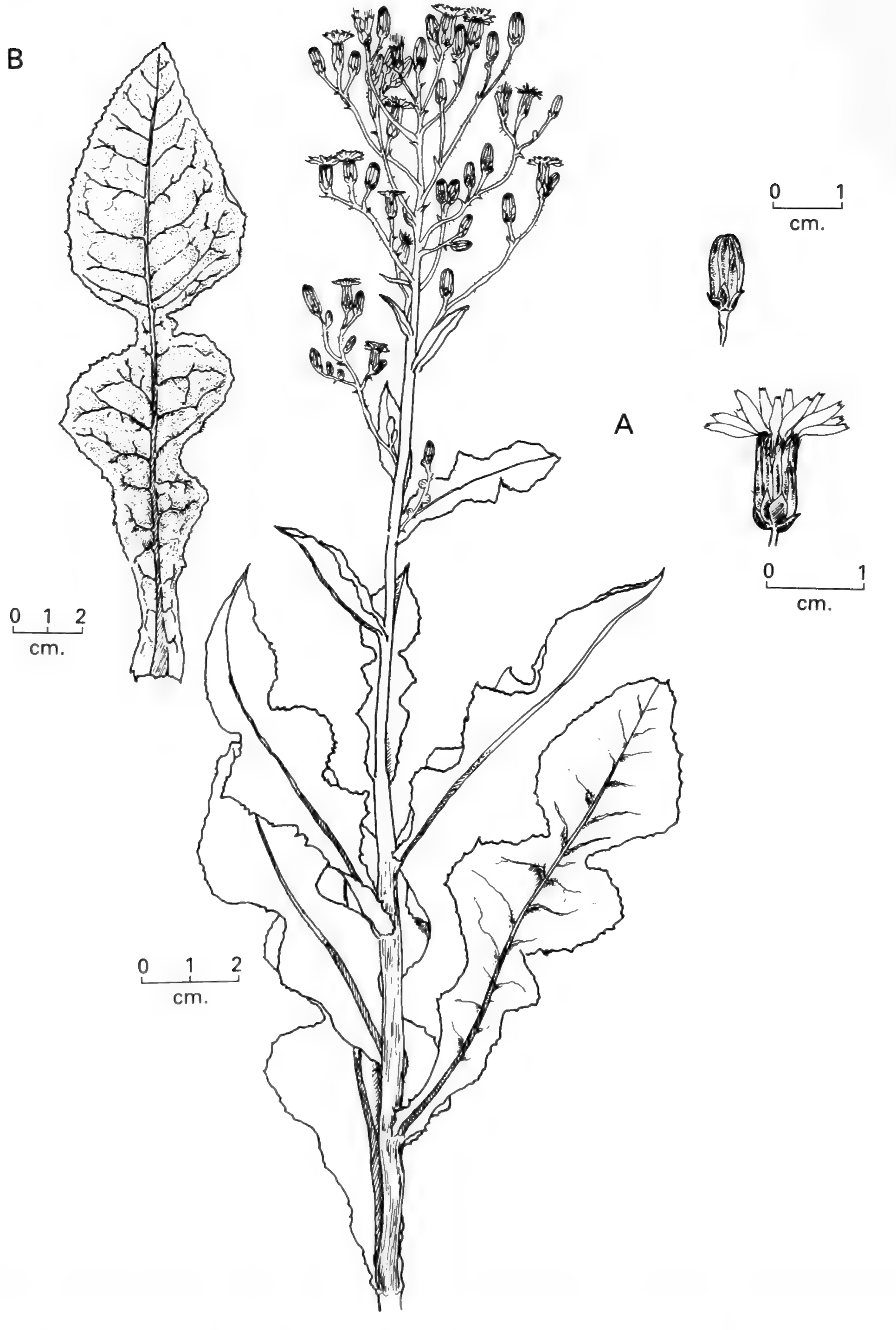

FIGURE 4. *Cicerbita bourgaei* (Boiss.) Beauverd; based on specimens from (A) Bucks., 10th July 1959, *May* (**RNG**); and (B) (basal leaf) Berks., August 1968, *Bowen 622* (**RNG**).

v.c. 95, Moray. Formerly abundant outside the walled garden at Brodie Castle, now exterminated with weed killer, 1967. M. McCallum Webster, *Fl. Moray, Nairn & E. Inverness* 372 (1978).

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I am grateful to John Akeroyd and Stephen Jury for making available to me all the notes they had accumulated since their paper in *B.S.B.I. News*, and to Eric Clement for lending me the relevant part of his card index of records. Others who have kindly sent records of *Cicerbita* are too numerous to mention. Chris Preston and the Biological Records Centre have provided the map of *C. macrophylla* subsp. *uralensis*. Fred Rumsey kindly allowed me to use his drawings to illustrate this paper.

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The past and present status of *Cicerbita alpina* (L.) Wallr. in Britain

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ABSTRACT

Cicerbita alpina (L.) Wallr. (Compositae) is a very rare plant in Britain, confined to remote mountain cliff ledges and gullies in the counties of Angus (v.c. 90) and Aberdeen (S. Aberdeen, v.c. 92). Its past and present distribution in Scotland is discussed in relation to the habitat of the species. Recent monitoring of populations at Lochnagar and Caenlochan suggests that flowering performance varies from year to year in response to climatic conditions in late summer and to the incidence of rockfalls. The grazing of sheep and red deer, combined with the decline of natural submontane woodlands, has increasingly confined the plant to montane cliffs, an atypical habitat to which it appears to be poorly adapted.

INTRODUCTION

Cicerbita alpina (L.) Wallr. (Compositae), the Alpine Blue Sow-thistle, is a very rare mountain plant in Britain and is one of 62 species protected under Schedule 8 of the Wildlife and Countryside Act of 1981. By contrast, it is a widespread and locally abundant species of submontane birch and pine forests in Scandinavia and in European mountain ranges southwards to the Pyrenees, northern Apennini and the mountains of the Balkan peninsula. *C. alpina* is a robust, perennial herb growing to a height of about 130 cm in Britain. Flowering shoots rise annually from a rhizome and the flower buds usually open in late July. The plant typically grows in large clumps and the broad, sagittate leaves cast a heavy shade. When the flowers first appear, they are an attractive shade of blue, but they soon wither to a dull bluish-violet, and the plants are often battered by winds and rainstorms by late summer. The seeds are surmounted by a pappus of long, stiff hairs but ripe seed is not always produced in Scotland. The habitat and autecology of *C. alpina* in Scotland have been summarized by Roger (1943) and Randall (1977).

THE DISCOVERY OF THE SCOTTISH SITES OF *CICERBITA ALPINA*

Cicerbita alpina was discovered in Britain by the great botanical traveller George Don in September 1801 on one of the precipitous ledges in the north-eastern corrie of Lochnagar. Don sent specimens gathered here to his correspondent Sir James Edward Smith, who published a description of the plant as *Sonchus caeruleus* Sm. (Smith 1811). Some of Don's specimens, which are seldom dated, are housed in the Smith herbarium (**LINN**) while others were given to private collectors, one of whose sheets is now in the herbarium of the Royal Botanic Gardens, Edinburgh (**E**). Don left no account of his discovery, but in a paper published the year before his death he mentions that he had also found "the *Sonchus* . . . on the rocks among the Clova mountains" (Don 1813; Druce 1904). He was thus also the first botanist to find the plant in one or more of its Angus localities. Abundant herbarium material from Glen Doll and Caenlochan dates from the 1820s onwards, and William Gardiner's *Flora of Forfarshire* (1848) lists no less than six localities in the former glen and "several" in the latter.

A further colony was subsequently found in Coire Kander, Glen Callater, although the precise date of its discovery is uncertain. Members of the Scottish Alpine Botanical Club believed that they had discovered this new site during a field excursion in 1878 (Boyd 1879). The 1866 edition of Sowerby's *English Botany*, however, lists *C. alpina* from "Glen Callater" (Ratcliffe 1958). George Dickie (1860) was unaware of any Aberdeenshire site other than Lochnagar when he compiled his *Botanist's Guide* to the north-eastern Scottish counties. It is equally uncertain when the little-known Angus station in Canness Glen first came to light. The earliest herbarium specimen that the authors have seen dates from 1866 (**ABD**).

No other British station for *C. alpina* has yet been found. From the time of Don onwards, there have been persistent reports of a blue-flowered sow-thistle from the Lake District and other upland areas of Britain but whenever it is possible to check these reports, the plant in question is invariably the widespread garden escape, *Cicerbita macrophylla* (Willd.) Wallr.* The British range of *C. alpina* is therefore confined to the block of mountainous terrain bounded by Deeside, Glen Muick, Glen Clunie and the glens of Angus, commonly known as the 'Clova mountains', although more properly termed 'The Mounth'. The reason for this unusually localized distribution is unknown. Few other montane vascular plants are confined to the eastern highlands of Scotland and, with the exception of *Homogyne alpina*, none are as local as *C. alpina*.

HABITAT REQUIREMENTS

Over 70 years ago, Smith (1911) classified *Cicerbita alpina* as a shade species that required a high degree of humidity and pockets of deep, permanently moist soil. The present-day localities of *C. alpina* lie either on precipitous north- and north-east-facing cliffs or in deep ravines. At Glen Canness and Glen Doll the sites are (or were) the stony beds of gullies and stream gorges, at 530 – 670 m. The Caenlochan, Lochnagar and Coire Kander sites are broad, flat cliff ledges with overhanging rocks, or sloping 'ramps', gullies and chimneys, at altitudes of 840–1090 m. Some, possibly all, of these sites regularly carry snow into the spring and even early summer. Although the famous inaccessability of the sow-thistle sites has been somewhat exaggerated by some authors, most of its stations do indeed "demand both a certain agility and a fair head for heights" (Raven & Walters 1956).

The parent rock of the Scottish localities is either igneous (Lochnagar and Caenlochan) or metamorphic (other sites). The geology of the *C. alpina* sites is complex; the parent rocks are all acidic but they commonly contain base-rich intrusions. The parent material at the Coire Kander locality is syenite, an acid pyritic rock (Ratcliffe 1958). The Caenlochan ledge lies in an area of hard, fine-grained granite with porphyritic crystals of quartz and felspar. Ferreira (1958) found that the flora of the quartz porphyry in this area closely resembled that of the syenite on Ben Loyal in Sutherland. The Lochnagar sites occur within, or close to, gullies containing crushed rock associated with fault zones where the typical grey or pink Lochnagar granite is replaced by cream or greenish, heavily weathered rock in which the base-rich minerals epidote and calcite may be frequent (Ferreira 1958). There is a strong likelihood that nutrients are transported to the *C. alpina* sites from base-rich rocks, both by percolation and by rock-falls.

The soils of *C. alpina* sites were described by Roger (1943) as granitic gravels mixed with peaty

*The '*C. alpina*' of Glenridding in the Lake District, for example, known to local botanists as "*Bob Nixon's Helvellyn Plant*", was correctly identified by Professor W. H. Pearsall as *C. macrophylla* (*B.E.C. Report* **1936**, p. 265). Don (1813) reported that "*S. coeruleus* is now lost at Howden Pans, in England" but he is unlikely to have known either the plant or the site at first hand.

humus and possessing a good depth and moisture-retaining capacity. Ratcliffe (1958) characterized the soil of the Coire Kander ledge as a "mull humus, poorer than the calcareous schists but somewhat enriched by the drip of water from material containing some bases." Although they have not been exhaustively analysed, these soils are probably analogous to those of other tall herb associations on mountain ledges, which are typically periodically irrigated, skeletal brown loams with mull humus and slight podsolization (McVean & Ratcliffe 1962). The soil reaction of the *C. alpina* sites varies from pH 4·8 to 5·9, that at Caenlochan showing a relatively high pH which is attributed to the constant drip of base-enriched water falling onto the ledge from above. The ledges on which *C. alpina* grows usually carry a luxuriant vegetation among which ptarmigan nests are sometimes found. Bird droppings and nest remains are a further probable source of soil nutrients locally.

C. alpina invariably grows in places where grazing is minimal, since it is extremely palatable to large herbivores, notably sheep and deer. It typically occurs in association with equally palatable plants, notably Hogweed (*Heracleum sphondylium*), and such luxuriant vegetation would offer an open invitation to grazing animals were it not for its inaccessibility. The largest colony on Lochnagar belies its altitude of c. 1000 m by possessing a lush plant community reminiscent of lowland ditch-sides and open woodland in Norway. *Athyrium distentifolium*, a species of late snow-beds, is a frequent associate of *C. alpina* in its higher sites, and other species which are usually present in abundance are *Alchemilla glabra*, *Deschampsia cespitosa*, *Dryopteris dilatata*, *Luzula sylvatica*, *Oxalis acetosella*, *Rumex acetosa* and *Solidago virgaurea*. A fuller list of close associates of *C. alpina* is provided in Table 1. Some sites have their own individual features; the Caenlochan ledge is characterized by the tall, robust stems of Hogweed, while in one of the Lochnagar colonies, the sow-thistle leaves mask exceptionally tall specimens of Frog Orchid (*Coeloglossum viride*). At a recently discovered station in Glen Doll there is a pronounced calcicolous element in the flora, which includes *Saxifraga aizoides*, *S. oppositifolia* and *Polystichum lonchitis*. We would agree with Ratcliffe (1958) that *C. alpina* appears to be tolerant rather than genuinely calcifuge.

The phytosociological affinities of the fragmentary *C. alpina* sites in Scotland are uncertain. McVean & Ratcliffe (1962) list *C. alpina* among the species exclusive to their Tall Herb nodum, which is "probably best regarded as an unorganized or fragmentary *Lactucion*", an alliance characterized by this species in Scandinavia. Huntley (1976) suggests that the Caenlochan ledge, at least, is close to the *Luzula sylvatica* nodum which is, in turn, related to a treeless facies of the woodland association, *Betuletum Oxaleto-Vaccinietum*. The Scottish sites for *C. alpina*, therefore, have close affinities with woodland vegetation and, in the Angus glens at least, the plant may once have been a constituent of submontane woods as in climatically comparable areas in Scandinavia. The Glen Doll and Canness localities are still partially wooded, and even the high, remote shelf on Lochnagar bears a flourishing rowan sapling.

The ecological amplitude of *C. alpina* in Scotland differs markedly from that in Europe, where it is a mainly submontane species, more typical of damp, open, lightly grazed woodland and scrub than the steep mountain crags of the Scottish sites. It is a characteristic species of Scandinavian tall herb meadows and one of its synonyms, *Lactuca alpina* (L.) A. Gray, lends its name to the alliance *Lactucion alpina* (McVean & Ratcliffe 1962). Such meadows are normally very wet and, in Scandinavia, *C. alpina* is commonly a ditchside plant.

THE SCOTTISH SITES OF *CICERBITA ALPINA*

LOCHNAGAR

Byron's "steep, frowning glories of dark Lochnagar" contain the largest remaining populations of *Cicerbita alpina* in Britain. All the known sites are within the north-eastern corrie. The best known station is a broad, sloping ledge at about 1000 m, mistakenly stated by Dickie (1860), following Watson's *Cybele Britannica*, to lie at 640–820 m. This was probably the ledge on which Don discovered the species in 1801. The plant was gathered there at intervals by the hardier botanists of the 19th century, including R. Mackay in 1845, J. Hutton Balfour (Balfour 1848, 1875), James Backhouse the younger in 1852, F. J. Hanbury in 1886, F. Buchanan White in 1886, and P. Ewing (Ewing 1887).

TABLE 1. SPECIES ASSOCIATED WITH *CICERBITA ALPINA*

Field data for vascular plants obtained by P.R.M. (1977–80, Lochnagar and Caenlochan), A.G.P. (1978–80, all sites), and R.E.R. (1976–77, Lochnagar, Caenlochan and Coire Kander). Literature references to all plants taken from McVean & Ratcliffe (1962) and Roger (1943).

Species	Locality					
	Caenlochan	Glen Doll	Canness	Lochnagar	Coire Kander	Unspecified
Vascular plants (co-dominants)						
Athyrium distentifolium	+			+	+	
Dryopteris dilatata	+		+	+	+	
Alchemilla glabra		+		+	+	
Oxalis acetosella	+			+	+	
Heracleum sphondylium	+	+			+	
Rumex acetosa		+		+	+	
Vaccinium myrtillus	+			+	+	
Solidago virgaurea	+	+	+	+	+	
Luzula sylvatica	+	+	+	+	+	
Deschampsia cespitosa	+	+		+	+	
Festuca ovina/vivipara	+			+	+	
Vascular plants (close associates)						
Gymnocarpium dryopteris	+				+	
Phegopteris connectilis	+				+	
Blechnum spicant						+
Polystichum lonchitis		+				
Anemone nemorosa		+				
Ranunculus acris				+		
Thalictrum alpinum					+	
Silene dioica				+		
Geranium sylvaticum					+	
Geum rivale	+	+				
Alchemilla alpina	+			+	+	
Saxifraga stellaris		+			+	
S. aizoides		+				
S. oppositifolia		+				
Rhodiola rosea		+			+	
Epilobium angustifolium				+		
Angelica sylvestris		+				
Empetrum hermaphroditum					+	
Oxyria digyna		+			+	
Rumex acetosella				+	+	
Euphrasia officinalis						+
Thymus praecox					+	
Galium saxatile					+	
Succisa pratensis	+					
Gnaphalium norvegicum				+		
Tussilago farfara		+				
Saussurea alpina	+			+	+	
Hieracium sp.				+		+
H. calenduliflorum				+		
Coeloglossum viride				+		
Carex bigelowii				+		
Agrostis capillaris						+
Anthoxanthum odoratum	+				+	
Deschampsia flexuosa	+				+	
Total no. vascular plants recorded	17	16	3[a]	21	26	4
Bryophytes[b]						
Sphagnum quinquefarium	+					
Plagiothecium undulatum					+	
Rhacomitrium lanuginosum						+
Dicranum majus					+	

Table 1 continued.

Species	Locality: Caenlochan	Glen Doll	Canness	Lochnagar	Coire Kander	Unspecified
D. scoparium	+					
Mnium punctatum	+					
Rhytidiadelphus loreus	+					
R. squarrosus					+	
Thuidium tamariscinum					+	
Hylocomium splendens					+	
Polytrichum commune	+					
P. piliferum						+
Diplophyllum albicans	+					
Lichens						
Cladonia rangiferina						+
C. cornuta						+

Other species recorded from the Lochnagar sites but less closely associated with *C. alpina* are *Antennaria dioica, Calluna vulgaris, Campanula rotundifolia, Cirsium heterophyllum, Cornus suecicus, Cryptogramma crispa, Huperzia selago, Juncus trifidus, Luzula spicata, Nardus stricta, Oreopteris limbosperma, Polygonum viviparum, Potentilla erecta, Salix lapponum, Sorbus aucuparia, Trichophorum cespitosum, Trollius europaeus, Vaccinium vitis-idaea, V. uliginosum* and *Viola palustris*.

[a] The small number of species recorded from Canness is almost certainly incomplete and does not necessarily mean this site was unusually species-poor.
[b] Not recorded at Glen Doll, Canness or Lochnagar.

C. alpina seems to have been present in good quantity throughout these years: Balfour found it "in great quantities", Buchanan White was pleased to find it "still abundant" and Young (1908) reported that it was "growing vigorously". The only quantitative statement is that of Ewing (1887) who counted about 150 plants. Although it is difficult to know what Ewing regarded as a single 'plant', this figure compares well with a count of 163 inflorescences in the most accessible station in 1983.

There are at least three main areas in which *C. alpina* grows on Lochnagar. These sites are all damp, shady gullies and rock 'chimneys' or broad ledges, which are kept moist by more or less constant percolation, and often carry snow until late in the summer. Some of the sites are on climbing routes, and local climbers' publications occasionally mention the plant in passing. One climbing party, for example, referred to a "veritable garden of ferns and flowers [which] included a large plant not unlike a dahlia" (Ewan 1932). The site became known by the irreverent name of "the potato patch".

The flowering performance of these populations of *C. alpina* fluctuates from year to year. Table 2 records the number of flowering stems in the three known colonies between 1972 and 1983. 'Site A' is a narrow, shady gully with a cave, at c. 1050 m, which contained a flourishing colony in the 1920s and 1930s. By the early 1970s, the population had declined, for reasons unknown, to four small and widely spaced clumps. 'Site B' is a broad north-east-facing ramp sloping at about 45°. This is one of the best known localities for *C. alpina*, for the flowers can easily be viewed from a distance although access to the ramp itself is another matter. Between 1967–1974, the population had fallen from just over 100 'plants' to 42 (H. J. B. Birks in Randall 1977). The decline was due to a natural rock-fall, a phenomenon of frequent occurrence in mountain gullies. Although such falls cause temporary disturbance, from which *C. alpina* normally has the capacity to recover, they also provide new nutrient supplies to the soil and may be beneficial in the long term. At any rate, *C. alpina* soon increased from about 30 stems in 1973 to a maximum of 311 in 1980, before abruptly decreasing again in the early 1980s. There was no fresh rock-fall to account for this but *C. alpina* appears to flower more prolifically in cool, wet seasons than in the hot, dry summers of 1982–84, and hence the reason for the second decline may be climatic. 'Site C', a narrow rock chimney beneath the ramp and even more difficult of access, shows parallel increases and declines of

TABLE 2. FLOWERING STEMS OF *CICERBITA ALPINA* ON LOCHNAGAR, 1972–1983
Data of A.G.P. and Claire Geddes

	Site A Clumps						
Date	1	2	3	4	Site B	Site C	Additional notes
24.8.72	0	1	few	few	many		
30.8.73					30+		
8.74					42		
9.8.75	0	0	6	0	many		
27.8.76					many	2+	
14.9.77	0	0	3	0	120+	22+	
23.8.78	0	0	6 veg. shoots	0	160	51	
4.8.79					222	75+	Most in bud
1.9.80	2	3	1	2 veg. shoots	311	73+	
17.8.81					53	50+	
3.8.82	5 veg. shoots	2 veg. shoots			46	15+	
28.7.83	1	2 veg. shoots			163	85+	All in bud

flowering shoots. The overall impression at Lochnagar is one of short term change but long term stability. The plants appear particularly healthy and robust and, here at least, there seems to be no immediate prospect of serious decline.

COIRE KANDER

The cliffs of Coire Kander in Glen Callater contain the second largest British population of *Cicerbita alpina*. The main colony grows as a dense mass on a broad, north-facing ledge at about 840 m with a smaller colony in a perpendicular gully nearby. Since the site is difficult to reach, there are few specimens from Coire Kander in herbaria. As a member of the Scottish Alpine Botanical Club put it, "no member was sufficiently foolhardy to break his neck in an attempt to scale the exact rock" (Boyd 1879). Ratcliffe (1958) counted 200 flowering stems but the population had declined to only 40 flowering stems by August 1972. Since there was no obvious physical cause, this colony was assumed to have "lost vitality" (Perring & Farrell 1983). Fortunately, as at Lochnagar, a recovery has since taken place. The population was monitored annually between 1977–1979 and the results are reported in Table 3. The increase of *C. alpina* at Coire Kander matches that at Lochnagar. A similar correlation between the drought years of 1975–76, which may have been the real cause of the 'lost' vitality, and the subsequent increase in the cool, wet summers of 1977–79 is suggested.

CAENLOCHAN GLEN

Caenlochan is probably the best known site for *Cicerbita alpina* in Britain. So far as the authors are aware, only one colony is known today and successive botanical pilgrims have worn a track along the base of the steep, north-facing cliff on which it grows. There were other stations in the glen in the 19th century. According to Gardiner (1848) it grew "in several places by the sides of streams at the head of Caenlochan glen". Ewing (1887) believed that there were no less than five patches, three of which he knew personally, although he did "not believe one collector in a hundred would undertake to gather a single specimen from any of the stations where I have seen it".

These statements imply that *C. alpina* was once less rare in Caenlochan Glen. Gardiner implies that it once occurred on the lower ground by the myriad burns which feed into Glen Isla, as well as on cliff ledges. Unfortunately the fate of these colonies cannot be traced, for herbarium labels seldom enable the exact location to be identified, and it is possible that *C. alpina* still occurs in

TABLE 3. *CICERBITA ALPINA* IN COIRE KANDER

Date	No. flowering stems	No. stems	No. plants	Recorder	Additional notes
30.7.77	67	160	30	R.E.R.	In bud
9.8.78	c.155	not recorded		A.G.P.	Mostly in bud
7.8.79	c.165	not recorded		A.G.P.	Mostly in bud

some of the inaccessible places referred to by Ewing. Nevertheless, the present solitary ledge seems always to have been the best known and consequently *C. alpina* was heavily collected there for at least 160 years. This population occupies a broad, flat ledge at c. 840 m with steep, overhanging rock-walls on the southern and western sides. The ledge has been visited annually for many years, although population data have been available only since 1972. The plants suffer from late summer wind and are often very battered by the time the flowers are in bloom. This population can never have been very large, because of the physical limitations of the site, and only 10–40 flowering shoots are normally produced. The data in Table 4 reflect the changing fortunes of this colony since 1975. After a dismal showing in the late 1970s, the Caenlochan plants are now showing encouraging signs of recovery. In 1977 a ramp of exceptionally late snow enabled grazing

TABLE 4. *CICERBITA ALPINA* IN CAENLOCHAN 1975–1983

Date of visit	No. flowering shoots	Total no. stems	Recorder	Condition
1975	12	"60 plants"	F. H. Perring	Damaged by wind
7.8.1975	0		A.G.P.	All flowering stems clean cut at 30 cm from ground. Much late snow forming ramp below ledge
27.7.1976	3 in bud	30–40	C. Geddes	
2.7.1977	12 in bud	80	J. Bevan & J. M. Mullin	
8.7.1977	12 in bud	(about 24 plants)	P.R.M.	Poor condition with browning leaves
1.8.1977	19	40	R.E.R.	Ten grazed stems at front of ledge
19.9.1977	30		A.G.P.	Plants mainly prostrate
10.8.1978	20		C. Geddes	Poor condition, only one well-developed flowering stem; others depauperate with browning leaves
6.7.1979	No sign of buds	50+	A.G.P.	
12.8.1979	6 in bud		A.G.P.	Many leaves browned
14.8.1979	8		N.C.C.	Three plants trampled at front of ledge
7.10.1980	41		N.C.C.	Poor, but no signs of interference
30.8.1981	14		C. Geddes	Good
27.7.1983	45 in bud		C. Geddes	Good

animals to reach the ledge. Recovery appears to have been slow and perhaps hindered by violent wind and human trampling. As with the Lochnagar populations, 1980 and 1983 were good years.

CANNESS GLEN

The Canness station of *Cicerbita alpina* is the least known and least visited – probably few botanists are inclined to forego the splendours of Caenlochan for the comparatively dull flora of the neighbouring Canness glen. Only one colony, a single large clump, was known and even this now appears to have declined to extinction.

The population was presumably in a reasonably healthy state in 1885, when a large number of flowering stems were removed (**BM**, **OXF**). The site was photographed by R. M. Adams in 1937, and his picture, together with its surprising background of larch trees, is illustrated in Holden (1952). The site was on a pocket of deep soil by the rocky bank of the Canness burn in a shady gorge which was normally isolated from the attentions of grazing sheep and red deer by a precipice and a deep pool. The larches, growing here at an altitude of c. 535 m, are the remains of a 19th century plantation.

In the late 1940s, possibly the dry summer of 1947, the Canness plants were grazed close by deer (U. K. Duncan pers. comm.). A tiny population, which produced 2–4 flowering shoots annually (Roger 1967; E. Jensen pers. comm), survived until 1976, when four flowering stems were recorded (C. Geddes pers. comm). In the following year, however, only a single shrivelled shoot remained and the colony now appears to be extinct. The hot, dry summer of 1976 seems to have marked the final demise of the population. Perhaps the low water level of the burn again allowed deer or sheep to reach the plants; or perhaps the drying and compaction of the soil resulting from the drought was responsible for the loss of the last few plants. More recent searches have been fruitless and any further sightings of *C. alpina* from Glen Canness would therefore be most welcome.

GLEN DOLL

Glen Doll has more well-authenticated stations for *Cicerbita alpina* than any other Scottish site. A number of streams, rising on the plateau, tumble down the steep, north-eastern faces of Craig Maud, The Dounalt and Craig Rennet in gloomy, boulder-strewn ravines to join the White Water in the glen below. At least six colonies of *C. alpina* once grew in gullies and on shelving rocks by the old stations in streams (Gardiner 1848) at altitudes of 700–800 m. One colony at least was in the bed of a burn and others grew on rocks kept permanently moist by waterfalls. In the 19th century, Glen Doll was both the best known and the most accessible of the *C. alpina* sites, and there is more herbarium material from this site than from any other.

By contrast, 20th century herbarium material is scarce and for many years it was feared that *C. alpina* had disappeared from all its former stations in the glen. Mrs T. J. Foggitt gathered it from a site on the Dounalt in 1921 and 1925 (**BM**), and U.K. Duncan (pers. comm) found a small population in a different place in 1930. This locality was rendered more or less inaccessible by a rock-fall in the early 1930s and, although the population seems to have survived, the plants had produced no flowers when the site was revisited shortly afterwards. The Dounalt population is also said to have survived a rock-fall but no subsequent observations are known to the authors. J. Raven (Raven & Walters 1956) was informed that *C. alpina* had disappeared in a flood from the best known locality in Glen Doll.

In September 1979, one of us (A.G.P.) discovered a healthy population of *C. alpina* in a narrow, north-facing gully blocked by a large 'chockstone'. 40 flowering stems were counted on the inaccessible floor of the gully above the chockstone and another four below. The majority of the plants were visible only from above and were virtually inaccessible except to rock climbers. Rock-falls and spates are evidently more frequent at Glen Doll than at the other localities and sudden, violent change was probably always a feature of the *C. alpina* sites, although the diminished numbers of the plant now render its survival more precarious. The blocking of gullies by rock-falls may well have hidden from view other populations recorded by Gardiner, or possibly botanists today are less adventurous climbers than were their 19th century counterparts. If so, the decline of *C. alpina* in Glen Doll may be more apparent than real, although it should be added that several parties have recently searched old localities in the glen without success.

FACTORS CONTRIBUTING TO THE PRESENT DAY RARITY OF *CICERBITA ALPINA*

LONG-TERM VEGETATION CHANGE

There are no fossil palynological records of *Cicerbita alpina* in Britain and, since the identification of pollen of the Compositae at species level is rarely possible, it is unlikely that any such evidence will be forthcoming. It is possible that, for unknown phytogeographical reasons, the species reached only the restricted block of mountains south-east of the Cairngorms during the early post-glacial. Equally, it may have been more widespread at first but became progressively restricted to its present day localities. The total absence of the species from cliff-ledge vegetation elsewhere in Britain points tentatively towards the former possibility.

C. alpina appears to have a narrower ecological amplitude in Britain than in more central parts of its range, a circumstance it shares with certain other arctic-alpine species such as *Cystopteris montana*. Whether the limited tolerance of this species in Britain is due to our Atlantic climate, some process of genetic attenuation, or some other reason, is unclear. It is apparent, however, that *C. alpina* did occur at lower altitudes in Scotland in the first few decades of the 19th century, and it may once have occurred in sub-montane woodland in situations closer to its typical continental habitats than the present day sites. The upland woods of eastern Scotland began to be exploited on a large scale only in the late 17th century, and many now almost treeless glens such as upper Glen Muick and Glen Isla are known to have possessed substantial woods of birch, juniper and pine in the past. The introduction of sheep farming in the late 18th century resulted in the clearance or neglect of many open, upland woods which, because of grazing and browsing, failed to regenerate. The situation was further exacerbated when the stocking of the highland glens with red deer became profitable in the 1850s and 1860s. Glens Muick, Callater, Isla (including Caenlochan and Canness) and Doll all became deer forests during the middle to late 19th century. Under these circumstances it is easy to imagine how a tall, palatable plant like *C. alpina* could be progressively restricted to cliff sites inaccessible to deer and sheep. Botanical lore has it that red deer regard *C. alpina* as a great delicacy and, having developed a taste for the plant, they will readily return to its localities in subsequent years for another 'bite of lettuce'. Although *C. alpina* has long been a decidedly infrequent treat for Scottish deer, we have direct evidence from the ill-fated colony in Canness Glen to underline the extreme vulnerability of this species to grazing.

C. alpina could never have been a common montane cliff plant in Scotland, for suitable cliff sites are relatively few and highly localized. Since its discovery in 1801, it is doubtful whether the total British population has ever exceeded a few hundred plants and, apart from a few apomictic species of hawkweed, it is probably the rarest mountain vascular plant in Britain. The fundamental cause of the present day rarity of *C. alpina* can be attributed to long term change in the vegetation of the upland glens whose land-use militates against the plant's survival except on inaccessible crags. Nevertheless the plant has continued to decline even in its remote refuges, for which other factors must be responsible. Some of the possible causes are examined below.

OVER-COLLECTING AND OTHER HUMAN DISTURBANCE

Cicerbita alpina, like many mountain plants, was heavily collected in the past. Gardiner (1848) noted that it was "eagerly sought for on account of its being one of the rarest and stateliest of our native alpine plants". Barton (1858) regarded it as "a great prize". The records suggest, however, that many who went in search of the plant failed in their objective or were deterred from collecting by the inaccessibility of its haunts. The herbaria of Oxford University Botany Department (**OXF**), the British Museum (Natural History) (**BM**), the Royal Botanic Gardens, Edinburgh (**E**) and the Dept of Botany, Aberdeen University (**ABD**) have been examined for dated gatherings and, although these collections may represent only a fraction of the total, some general conclusions can be drawn (Table 5).

The data presented in Table 5 suggest that collecting was at its most intensive in the middle decades of the 19th century and that the Glen Doll plants were by far the most intensively collected. Heavy collecting is not necessarily evidence for the cause of a plant's decline, although it is tempting to see some correlation between the very precise locality details given for Glen Doll by Gardiner (1848) and the rarity of the plant there today. Very few herbarium specimens, however, include portions of root or rhizome, and this species is unlikely to have been popular with alpine gardeners, for its ungainly habit and aggressive growth make it unsuitable for the rockery. Most

TABLE 5. ANALYSIS OF DATED GATHERINGS OF *CICERBITA ALPINA* FROM SCOTLAND AT **ABD, BM, E** AND **OXF**

(a) Decade	pre-1820	1820s	1830s	1840s	1850s	1860s	1870s	1880s	1890s	1900s	1910s	1920s	1930s	post-1940
Number of gatherings	1	3	19	11	5	11	11	11	2	7	3	3	3	2

(b) Locality	'Glen Clova'	Glen Doll	Caenlochan	Coire Kander	Lochnagar	Canness
Number of Gatherings	12	41	21	4	11	4

collectors seem to have been satisfied with a flowering stem and a radical leaf. Since such stems are produced annually from a perennating organ and the plant probably does not rely on regular seed production to maintain its numbers, it is unlikely that collecting ever made much difference in the long term.

Disturbance by trampling or photographic 'gardening' takes place on some sites today. Bootprints on and below the Caenlochan ledge are not infrequent, although those who use this ledge may not always be botanists (see next section). Two of the Lochnagar sites lie on a classic but now little-used climbing route, but we have no evidence that climbers damage the plants.

GRAZING AND CUTTING

The basal leaves of *Cicerbita alpina* are almost succulent and the plant's extreme sensitivity to grazing is well-attested. Its restriction to cliff ledges and other inaccessible sites is attributed to the attentions of red deer and sheep, but even remote ledges are not always free from grazing pressure. Boyd (1879) saw several sheep apparently trapped on precipitous ledges in Corrie Kander. Adam (1930) counted 60 goats on the same ledges and Lochnagar, whose name means 'Loch of the Goats', also held a substantial goat population in the past. Mountain hares and voles seem to find little difficulty reaching cliff ledges, probably aided by ramps of late snow, and hare damage was suspected at Caenlochan in 1969 (F. H. Perring, pers. comm.). The authors have seen voles and hares in a Lochnagar colony. It is believed that deer occasionally manage to reach and graze the Caenlochan ledge in exceptionally late seasons when snow forms a ramp below the *C. alpina* colony at the time when it is coming into leaf. This appears to have happened in 1977 when the plants on the near side of the ledge showed clear signs of nibbling. The plants on this ledge were also cut in 1975 but probably not by deer. On 7th August 1975, the flowering stems of the sow-thistle and those of neighbouring hogweeds were neatly severed about 30 cm from the ground. Lying amid the ruins was a whisky bottle whose former contents had clearly been consumed very recently! Such occasional events clearly influence the plants' ability to flower and set seed, but whether or not they are contributing factors to the apparent long-term decline is less certain.

FAILURE TO SET RIPE SEED

Cicerbita alpina is pollinated by nectar-seeking insects such as bees and butterflies, which possess sufficiently long tongues to reach the hidden, deep-seated nectaries (Willis & Burkhill 1902). One of us (A.G.P.) has seen Small Tortoiseshell butterflies (*Aglais urtice*) fluttering about and settling on the flowers of a Lochnagar colony. The flowering period is comparatively late and, in some years, perhaps most years, the flowers fail to set ripened seed. In 1972 and 1974, Dr G. Miller collected *C. alpina* seed from the Caenlochan colony, under licence from the Nature Conservancy Council, but it failed to germinate and appeared to be shrunken and not fully formed. Equally malformed, unripened seed was found at Lochnagar in 1979 and 1980. No conclusions can be drawn from so few collections and *C. alpina* evidently does succeed in ripening seed in Scotland on occasion, since both young plants and seedlings have been reported recently from Lochnagar and Coire Kander (Hobbs 1980) and at least one herbarium specimen (**BM**) was grown from wild seed.

The extreme isolation of the Scottish colonies of *C. alpina* must mean that cross-fertilization between populations is unlikely to occur, but whether this circumstance might have led to some self-infertility through reduction of the gene-pool is not presently known. From the clumped habit of the plants at Caenlochan, it is possible that this colony, at least, is a clone (G. Miller, pers. comm.).

NATURAL DISASTERS

The present-day localities of *Cicerbita alpina* are vulnerable to the extreme conditions associated with mountain gullies and ledges. Strong winds and storms batter the tall inflorescences in late summer, while some localities are particularly prone to flash floods, rock-falls and drought. A rock-fall reduced the size of the largest population on Lochnagar for a time, and the Glen Doll localities have suffered a number of severe falls, some of which may have extirpated a colony. The vigorous, rhizomatous growth of *C. alpina* normally enables the plant to recover well after such events but in small or weakened populations this capacity for recovery may be diminished, and the isolation of most sites means that natural recolonization is unlikely once a colony has become extinct.

CONCLUSIONS

Cicerbita alpina is usually a plant of sub-montane woods, and does not appear to be well adapted to Scottish mountain cliff conditions. It is dependent on pockets of deep soil in sheltered, humid conditions which approximate to that of woodland. Here, erratic flower and seed production, natural spates, droughts, strong winds and rockfalls, and occasional grazing and human disturbance continue to affect the few remaining populations. Of the 15 or so populations recorded since 1801, only seven are known to survive. The losses have all taken place in the Angus glens, mainly on sites of relatively low altitude where the populations were perhaps more vulnerable to occasional grazing. Loss of natural woodland, which characterizes the land-use history of the highland glens from the 17th century onwards, may have confined this species to remote, inaccessible sites and possibly reduced its usual insect pollinators. The Glen Doll populations may have been over-collected in the 19th century but the main reason for their decline appears to have been chance events such as spates and rockfalls. On the other hand, there is no reliable evidence to suggest that the total populations in Coire Kander and the north-eastern corrie of Lochnagar have greatly declined since their discovery. We are unlikely to witness the extinction of *C. alpina* in Scotland in the immediate future, but the long-term prospects of the species are not favourable. *C. alpina* was given legal protection from collecting or wilful destruction in the Conservation of Wild Creatures and Wild Plants Act of 1975 and the Wildlife and Countryside Act of 1981. The Scottish localities all lie within Sites of Special Scientific Interest; two are also within the Caenlochan National Nature Reserve, whilst Lochnagar is a nature reserve of the Scottish Wildlife Trust. However, in order to conserve the plant we require a better understanding of its biology. A useful avenue of research would be to establish the breeding mechanism of the species in Britain in order to test whether or not the evident infertility of the seed has a genetic cause. If it has, artificial cross-pollination between the isolated populations might produce some improvement in vigour although the remoteness and inaccessibility of the sites of this species provide practical problems. Introductions or re-introductions from wild propagules could be attempted in suitable areas which have been fenced against grazing animals, and an interesting experiment would be to introduce the species into an ungrazed, sub-montane wood. A possible site is the National Nature Reserve of Morrone Birkwood, near Braemar, in which a number of arctic-alpine species such as *Juncus alpinus*, *J. triglumis* and *Potentilla crantzii* still grow in open birch woodland, in conditions recalling early post-glacial times.

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Natural hybrids between *Festuca* and species of *Vulpia* section *Vulpia*

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ABSTRACT

The occurrences and characteristics of the intergeneric hybrids between *Festuca rubra* L. agg. and *Vulpia bromoides* (L.) S. F. Gray and *V. myuros* (L.) C. C. Gmelin (Poaceae) are detailed. The hybrid of *V. bromoides* has been found on five occasions in three localities in England, involving both *F. rubra* and *F. nigrescens* as the other parent. The hybrid of *V. myuros* has been found on five occasions in four localities in England and Wales, and once in Holland, also involving both *F. rubra* and *F. nigrescens* as the other parent. Studies of meiosis in the hybrids show that the chromosomes of *F. rubra* can exchange genetic material with those of both *V. bromoides* and *V. myuros*, although both hybrids are very highly sterile. The significance of these facts to the evolution of *F. rubra* agg. is discussed.

INTRODUCTION

THE GENUS *FESTUCA*

Festuca contains several hundred species, which were placed in six sections by Hackel (1882). One of these sections, *Ovinae* (= *Festuca*), consists largely of the *F. rubra* and *F. ovina* aggregates, and included eleven species in Hackel's classification. Resulting from the extensive taxonomic splitting which has taken place in the last 100 years within the above two aggregates, Markgraf-Dannenberg (1980) recognized 129 species (out of a total of 170 for the genus) that are referable to section *Festuca*. 91 of these fall into *F. ovina* sensu Hackel and 21 into *F. rubra* sensu Hackel.

14 of the latter 21 form our concept of the *F. rubra* aggregate. These are species 65 to 78 in *Flora Europaea* (Markgraf-Dannenberg 1980), which correspond to Hackel's *F. rubra* subspp. *eu-rubra*, *pyrenaica*, *dumetorum* and *nevadensis*. Five of Markgraf-Dannenberg's 14 species occur in Britain: *F. rubra* (with five subspecies: *rubra*, *litoralis* (G. F. W. Meyer) Auquier, *arenaria* (Osbeck) Syme, *pruinosa* (Hackel) Piper and *juncea* (Hackel) Soó), *F. richardsonii* Hooker, *F. juncifolia* St Amans, *F. diffusa* Dumort. and *F. nigrescens* Lam. All members of the *F. rubra* aggregate are perennials with extra-vaginal non-flowering shoots (often as rhizomes), and have leaf-sheaths which are closed to the mouth (hence lacking infolded thin margins). Chromosome number reports vary from diploid to decaploid (2n = 14, 28, 42, 56, 70); the hexaploids are by far the commonest and octoploids are the only other frequently occurring plants. Some taxa do exist at more than one ploidy level, but a number of reports of this phenomenon are based on misidentifications. All the taxa are chasmogamous and behave as outbreeding diploids; figures above 10% self-fertility are very exceptional (Auquier 1977; Barker & Stace 1982).

Taxa of the *F. rubra* aggregate are the only members of *Festuca* which have been found to hybridize with the genus *Vulpia*.

THE GENUS *VULPIA*

Vulpia consists of about 20 species, which are currently placed in five sections (Cotton & Stace 1977; Stace 1978, 1981). Species of section *Vulpia* differ markedly from all species of *Festuca* in their annual habit, cleistogamous florets with usually only one or two stamens, and usually markedly unequal glumes. In addition they have overlapping leaf-sheaths and only intravaginal innovations, and are fully self-fertile. Each species is characterized by a single chromosome number at the diploid (e.g. *V. bromoides* (L.) S. F. Gray), tetraploid (e.g. *V. ciliata* Dumort.) or hexaploid (e.g. *V. myuros* (L.) C. C. Gmelin) levels (2n = 14, 28, 42).

However, species of the other four sections approach *Festuca* more closely, but to varying degrees. Species of the western Mediterranean section *Loretia* (Duval-Jouve) Boiss. are highly self-incompatible diploids having chasmogamous florets with three large anthers, and one species (*V. sicula* (C. Presl) Link) is a perennial. In other respects (e.g. the markedly unequal glumes) *V. sicula* is easily separable from *Festuca*, but without such a combination of characters it is impossible to separate the two genera. However, their taxonomic distinctness or otherwise is not a matter for discussion here.

Species of the remaining three sections of *Vulpia* are intermediate between those of sections *Vulpia* and *Loretia* in several ways. Sections *Spirachne* (Hackel) Boiss. and *Apalochloa* (Dumort.) Stace each contain one diploid self-fertile annual species, exhibiting semi- chasmogamous and chasmogamous flowering respectively. Section *Monachne* Dumort. contains four semi-chasmogamous self-fertile annual species, all but *V. fasciculata* (Forsskål) Fritsch, which is tetraploid, being diploids.

INTERGENERIC HYBRIDS (× *FESTULPIA* MELDERIS EX STACE & COTTON)

An extensive programme of crossing carried out by C. M. Barker (Barker & Stace 1982, 1984, in press) obtained the following intergeneric combinations (female parents first): *V. sicula* (diploid) × hexaploid *F. rubra* agg.; hexaploid *F. rubra* agg. × *V. sicula* (diploid); *V. sicula* (diploid) × octoploid *F. rubra* agg.; *V. fasciculata* (tetraploid) × hexaploid *F. rubra* agg.; and *V. myuros* (hexaploid) × hexaploid *F. rubra* agg. Hence the *Vulpia* parents included species from three different sections (all of those used), both annuals and perennials, and all three ploidy levels. The *Festuca* parents included both ploidy levels used and six of the eight segregate taxa used: *F. rubra* subspp. *rubra, arenaria* and *pruinosa, F. nigrescens, F. diffusa* and *F. juncifolia*. Earlier, R. Cotton had synthesized the hybrid *V. fasciculata* × *F. rubra* subsp. *rubra* with considerable success (Stace & Cotton 1974).

In Barker's experiments two of the 20 plants obtained of hexaploid *F. rubra* agg. × *V. sicula* (diploid) (both involving the same plant of *F. nigrescens* as female parent) were unexpectedly heptaploid, presumably resulting from unreduced female gametes. These two plants exhibited about 60% pollen stainability, though no seed-set has been detected. All the other hybrids possessed the expected intermediate chromosome numbers and were highly sterile, with very rarely as high as 1% pollen stainability.

Morphologically the artificial hybrids were more or less intermediate between their parents in appearance and, in the cases involving *Vulpia myuros* and *V. fasciculata*, they closely resembled wild hybrids.

Wild hybrids are known between the *Festuca rubra* aggregate and three species of *Vulpia: V. fasciculata, V. bromoides* and *V. myuros*.

Many details of the natural intergeneric hybrids involving *V. fasciculata* (as *V. membranacea*

TABLE 1. DIAGNOSTIC MEASUREMENTS OF FOUR × *FESTULPIA* COMBINATIONS AND THE 1961 COLLECTION FROM LITTLEHAMPTON

The ranges given for *F. rubra* × *V. myuros* and *F. rubra* × *V. bromoides* are derived from the wild collections detailed in Tables 4 and 2 respectively. Figures are ranges of means per inflorescence. Glume lengths include awns; lemma lengths exclude awns and refer to only the first and second lemmas of each spikelet; awn lengths refer to the longest in each spikelet.

	F. rubra × *V. myuros*	*F. rubra* × *V. bromoides*	Littlehampton hybrid 1961	*F. rubra* × *V. fasciculata*	*F. juncifolia* × *V. fasciculata*
Lower glume length (mm)	1·5–3·3	2·0–3·4	3·0–3·7	2·4–4·4	5·2–8·0
Upper glume length (mm)	3·2–5·0	3·4–5·9	6·2–7·4	3·5–7·2	8·0–11·5
Glume ratio	0·48–0·7	0·5–0·75	0·45–0·58	0·55–0·69	0·6–0·69
Lemma length (mm)	4·5–6·2	4·5–7·0	7·5–8·4	6·0–9·5	9·5–10·5
Awn length (mm)	3·0–6·0	3·2–6·0	5·7–7·2	2·0–5·5	3·5–5·0
Anther length (mm)	0·6–1·5	0·8–1·7	1·6–1·7	1·5–2·0	1·5–2·0

(L.) Dumort.) were given by Stace & Cotton (1974) and Willis (1975), and further data have been provided by Barker & Stace (1984, in press), and by Stace & Ainscough (1984) on the progeny of one of these hybrids. A summary of diagnostic measurements is provided in Table 1. The number of taxa of the *F. rubra* aggregate which have produced natural hybrids with *V. fasciculata* is uncertain, but both hexaploids and octoploids are involved, producing pentaploid and hexaploid hybrids respectively. On the basis of morphological characters Stace & Cotton (1974) deduced that the British hexaploid and octoploid *Festuca* taxa were *F. rubra* and *F. juncifolia* respectively, and they named the two hybrids × *Festulpia hubbardii* Stace & Cotton and × *F. melderisii* Stace & Cotton respectively. However, it is possible that the octoploid parent of × *F. melderisii* was actually *F. rubra* subsp. *arenaria*, which exists as both hexaploids and octoploids, and in fact the precise distinction between *F. rubra* subsp. *arenaria* and *F. juncifolia* is unclear. Which hexaploid taxa of *F. rubra* agg. are involved in the parentage of × *F. hubbardii* in Britain is also uncertain, but the restricted habitat (sand-dunes) involved suggests only *F. rubra* subspp. *rubra* and *arenaria*.

Pentaploid × *Festulpia hubbardii* occurs in many places on the coasts of southern Britain, from E. Kent to S. Lancashire, while hexaploid × *F. melderisii* has been confirmed from only two localities in south-eastern England (Fig. 1).

This paper presents data on natural hybrids between the *Festuca rubra* aggregate and the other two species of *Vulpia: V. bromoides* and *V. myuros*. Their known occurrences in the British Isles are shown in Fig. 1.

FESTUCA RUBRA AGG. × *VULPIA BROMOIDES*

OCCURRENCE

1. Coastal sand-dunes at Littlehampton, W. Sussex, 1961, *A. Melderis* (**BM**) (Melderis 1965), close to plants of both parents as well as of *V. fasciculata,* × *F. hubbardii* and × *F. melderisii*. *Festuca rubra* subspp. *rubra* and *arenaria* and *F. juncifolia* occur in the immediate vicinity. We have not traced a voucher specimen of the original collection, but a garden-grown specimen (coll. 1964) of the original plant is in **BM**. We have no doubt that it is *F. rubra* × *V. fasciculata*. Its measurements fall within the range of the latter hybrid and outside those of *F. rubra* × *V. bromoides* (Table 1). Most of the upper glumes have a distinct awn and the pedicels are distinctly dilated distally (both characters of the *V. fasciculata* hybrid but not of the *V. bromoides* hybrid). Searches for *F. rubra* × *V. bromoides* in the locality have not been successful.
2. Ten plants on fixed shingle at Shingle Street, E. Suffolk, 1969, *P.J.O. Trist* (**K**, det. C. E. Hubbard). The only other species of *Vulpia* in the area is *V. myuros*, whose hybrids with *F. rubra* are of different appearance. The hybrid has been sought there in several subsequent years by Trist, but was refound only in 1973 (two plants) and 1976 (one plant). A specimen collected on the last occasion is in cultivation at Leicester. All material of *F. rubra* near the hybrid at Shingle Street is subsp. *rubra*, though subsp. *litoralis* occurs within a few hundred metres.
3. On ballast by railway sidings, East Ella, Hull, S.E. Yorkshire, 1980, *J.E.L. Spencer* (**LTR**). It was growing with *Vulpia bromoides*, *V. myuros* and *Festuca nigrescens*, and was determined by C. A. Stace as probably *F. nigrescens* × *V. bromoides*. It has been searched for in subsequent years by Spencer, but without success.
4. One plant on cinders of a disused railway line at Leire, Leicestershire, 1983, *C.A. Stace* (**LTR**). This is being cultivated at Leicester. *Festuca rubra* subsp. *rubra* and *F. nigrescens* occur in close proximity, but *V. bromoides* is the only species of *Vulpia* in the area. The *Festuca* parent is probably *F. rubra* subsp. *rubra* as the hybrid has a limited rhizome development.

CHARACTERISTICS

Festuca rubra × *Vulpia bromoides* closely resembles × *F. hubbardii* in most characters. Vegetatively the characters of the *Festuca* parent are dominant: the plants are densely caespitose perennials with many non-flowering shoots, some of which are extravaginal in origin and in some plants form short rhizomes. The leaf-sheaths are closed almost to the mouth (not overlapping as in *Vulpia*), and are pubescent in those hybrids involving a pubescent *Festuca* parent (always glabrous

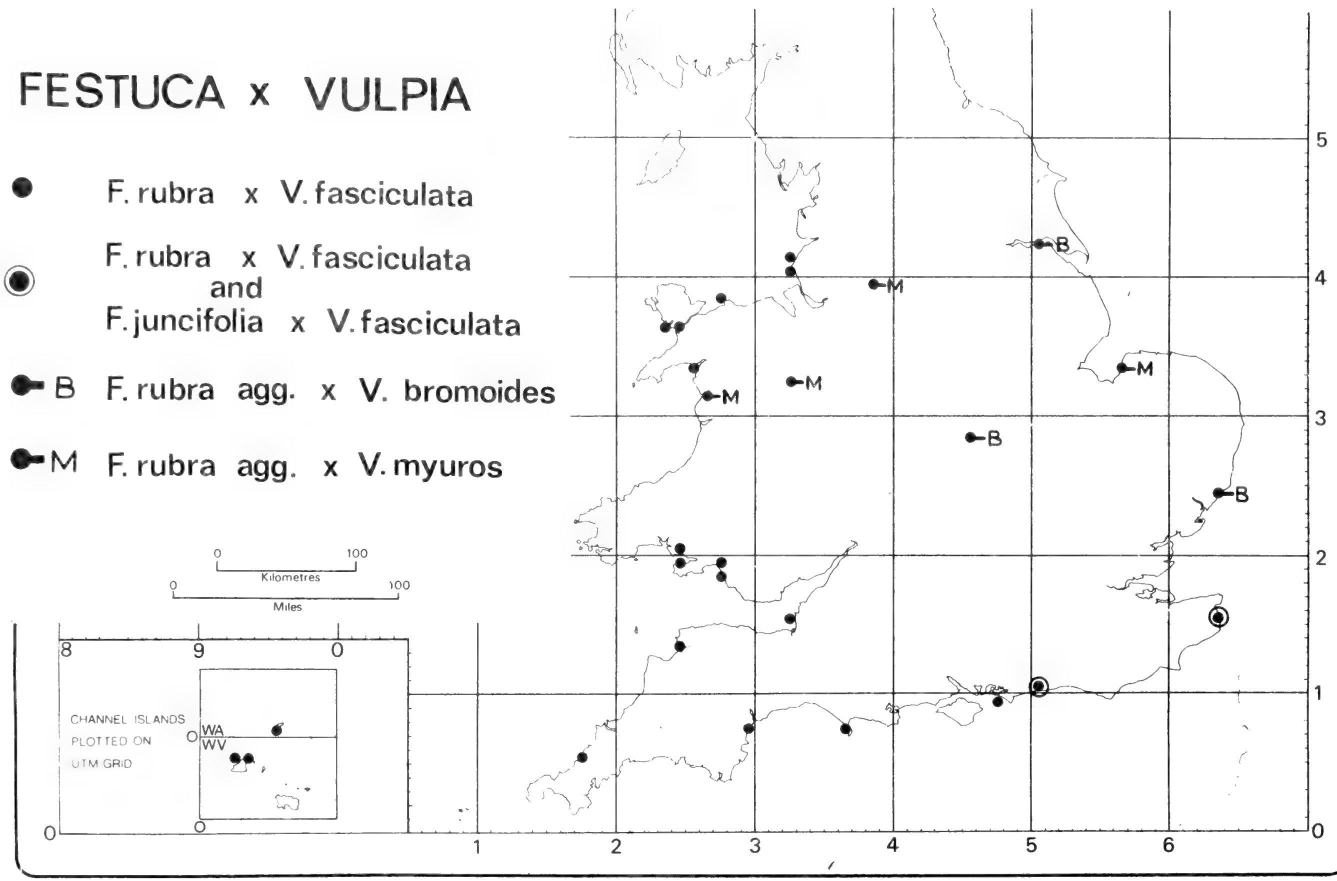

FIGURE 1. Distribution of four taxa of × *Festulpia* in the British Isles. For *F. juncifolia* × *V. fasciculata*, only the two cytologically confirmed hybrids are shown. Records of pubescent hybrids in S. Devon (20/97) and Glam. (21/78) might refer to this hybrid or to *F. rubra* × *V. fasciculata*, but in both places undoubted *F. rubra* × *V. fasciculata* also occurs.

in *V. bromoides*). The leaf-blades are intermediate in anatomy and morphology, being more slender and with less sclerenchyma than in *F. rubra*. The floral characters are intermediate. The inflorescence is more one-sided than in *F. rubra*, and the awns are longer. The glume ratio is the same as in *V. bromoides*, i.e. lower than that in *F. rubra*. There are three stamens, as in *F. rubra*, but they are indehiscent and shorter than those of *F. rubra*, though longer than the usually single stamen of *V. bromoides*.

It is best distinguished from × *F. hubbardii* by its thin, not distally thickened, pedicels; by the spikelets usually having only one ovary-less floret at the apex, the lemmas of the other florets varying little in length; and by the awn-less, rather than distinctly awned, upper glumes. In × *F. hubbardii* there are usually two or three apical ovary-less florets, and the lemmas diminish markedly in length acropetally. In fact there is no *Vulpia fasciculata* (the parent of × *F. hubbardii*) in localities 2–4 above.

The characters of *F. rubra* × *V. bromoides* vary not only according to the characteristics of the *Festuca* parent, but also with environmental conditions. Living plants grown at Leicester have shown significant differences in some characteristics from year to year. An indication of the range of variation shown by this hybrid is given in Table 2.

Chromosome counts have been made of the E. Suffolk (1976) and Leics. (1983) plants; in both cases the surprising count of 2n = 42 was obtained, whereas 2n = 28 would have been expected. Stace & Ainscough (1984) have attempted to explain this anomaly on the basis that the two plants in question are actually backcrosses to *Festuca rubra*, not F_1 hybrids. Pollen stainability is less than 1% (0·1–0·7%) in all cases, and no seed-set has been observed.

Attempts to synthesize hybrids between *V. bromoides* and a range of taxa of *F. rubra* agg. have been unsuccessful.

CHROMOSOME BEHAVIOUR

Meiotic analyses were undertaken on the plants from E. Suffolk (collected 1976) and Leics. (Table 3). The former plant gave significantly different results in 1978 and 1984, the later ones agreeing very closely with results obtained from the Leics. plant in 1984. The 1984 results produced means of 16·0 and 14·38 bivalents per cell, of which 11·2 and 11·75 respectively were ring bivalents, amounting to a rather high degree of pairing. Multivalents were very rare or absent. The 1978 results showed a much lower pairing affinity, with a mean of only 7·8 bivalents and many more univalents, although there were more trivalents, quadrivalents and quinquevalents. More technical problems were encountered in 1978, and the results are less accurate than those of 1984, but the differences are so marked as to be undoubtedly real (note, for example, mean numbers of univalents of 20·3 and 9·7 respectively). Chiasma frequency (26–28 per cell in 1984) is high for a 2n = 42 hybrid. Despite this, pollen grain stainability is very low and no seed-set has been observed.

TABLE 2. DIAGNOSTIC MEASUREMENTS OF FIVE WILD COLLECTIONS OF *FESTUCA RUBRA* AGG. × *VULPIA BROMOIDES*

Figures are ranges of means per inflorescence. Glume lengths include awns; lemma lengths exclude awns and refer to only the first and second lemmas of each spikelet; awn lengths refer to the longest in each spikelet. Dates indicate year of collection.

	Shingle Street				
	1969	1973	1976	Hull	Leire
Lower glume length (mm)	2·0–3·1	2·1–3·0	2·5–3·4	2·1–3·1	2·0–2·5
Upper glume length (mm)	3·9–5·8	4·0–4·6	4·5–5·9	3·4–5·2	3·5–4·4
Glume ratio	0·5–0·62	0·5–0·65	0·52–0·62	0·51–0·75	0·53–0·71
Lemma length (mm)	5·7–6·5	4·5–6·2	5·9–7·0	5·1–6·4	5·0–5·7
Awn length (mm)	5·0–6·0	3·6–5·4	3·2–5·0	3·4–5·1	3·7–5·3
Anther length (mm)	1·1–1·6	1·5–1·7	1·1–1·3	0·8–1·2	0·9–1·5

TABLE 3. MEIOTIC ANALYSES OF FIVE × *FESTULPIA* HYBRIDS

Figures represent ranges and (in brackets) means. The term 'chromosome pairs' represents the number of bivalents plus a minimum number to take account of the multivalents. Dates represent year of observation.

Chromosome configurations	*F. rubra* × *V. bromoides* Shingle St 1978	*F. rubra* × *V. bromoides* Shingle St 1984	*F. rubra* × *V. bromoides* Leire 1984	*F. rubra* × *V. myuros*	*V. myuros* × *V. diffusa*
V	0–1 (0·1)	0	0	0	0
IV	0–4 (0·4)	0	0	0–2 (0·3)	0–1 (0·2)
III	0–3 (1·2)	0–1 (0·1)	0	0–1 (0·1)	0–1 (0·2)
II (total)	5–14(7·8)	13–19(16·0)	11–18(14·4)	9–18(13·6)	15–20(17·8)
II (ring)	—	8–18(11·2)	9–15(11·8)	4–16(9·2)	9–20(14·4)
II (chain)	—	1–8 (4·8)	1–5 (2·6)	0–9 (4·4)	0–8 (3·4)
I	12–27(20·3)	4–16(9·7)	6–20(13·3)	6–24(13·3)	2–12(5·4)
Chromosome pairs	7–14(10·0)	13–19(16·1)	11–18(14·4)	9–18(14·3)	15–20(18·2)
Chiasmata per cell	—	22–37(27·9)	20–32(26·1)	16–32(24·3)	26–40(33·2)

FESTUCA RUBRA AGG. × *VULPIA MYUROS*

OCCURRENCE

1. On rubble by road just east of Mawddach Crescent, Arthog, Merioneth, 1957, *P.M. Benoit* (**LTR**, **NMW**); and on disused railway track 690 m south-east of this locality, 1970, *P.M. Benoit* (**LTR**). Searched for unsuccessfully in the area in other years. In both cases one plant appeared with *V. myuros* and *F. rubra* subsp. *rubra*, which are presumed to be the parents even though both hybrids show no rhizome development. Both are still (1984) grown in P. M. Benoit's garden in Barmouth, Merioneth.
2. On cinders in railway sidings immediately north of Stockport Station, S. Lancashire, 1974, *R. Cotton & C.A. Stace* (**LTR**). The only species of *Vulpia* present was *V. myuros*, and the commonest *Festuca* immediately adjacent was *F. nigrescens*; these are presumed to have been the parents.
3. On sandy shingle bank near sea at Snettisham, W. Norfolk, 1974, *R.P. Libbey* (**LTR**). A sample of this plant is in cultivation at Leicester. The commonest related plants in the immediate vicinity are *Festuca rubra* subsp. *litoralis* and *Vulpia myuros*, which are presumed to be the parents.
4. Between cobble-stones at old railway station, Woensdrecht, Noord Brabant, Netherlands, 1978, *E.J. Weeda* (**L**, **LTR**). This is the only confirmed example of × *Festulpia* from outside Britain. It was determined originally as *F. rubra* agg. × *V. bromoides* by C. A. Stace, but it is probable that *V. myuros* rather than *V. bromoides* was involved. It has not been refound. The only other relevant taxa found at the same site were *V. myuros* and *F. nigrescens*, which were the likely parents.
5. Two plants on disused railway line near Oswestry, Salop, 1983, P.M. Benoit (in litt.). *Festuca rubra* subsp. *rubra* and *Vulpia myuros* were the only possible parents in the area.

CHARACTERISTICS

This hybrid is extremely similar to the last in all characters, and may not be always distinguishable from it. However, all specimens seen lack any rhizome development. Unfortunately, whereas glume ratio is a very important character for separating *V. myuros* and *V. bromoides* (as well as *V. fasciculata*), the dominance of the subequal glumes of *F. rubra* produces a similar glume ratio in hybrids between *F. rubra* and all three species of *Vulpia*. The best character for distinguishing the *V. bromoides* and *V. myuros* hybrids is the inflorescence shape, which is very long and narrow in the latter, but shorter and often more spreading in the former. The lemmas are usually narrower and more gradually tapering in the *V. myuros* hybrid. Some characteristics of this hybrid are given in Table 4. Again, variation is probably an effect both of the different *Festuca* parent involved and

TABLE 4. DIAGNOSTIC MEASUREMENTS OF FIVE WILD COLLECTIONS AND ONE ARTIFICIAL HYBRID OF *FESTUCA RUBRA* AGG. × *VULPIA MYUROS*

Rubric as in Table 2.

	Arthog					*V. myuros* ×
	1957	1970	Stockport	Snettisham	Holland	*F. diffusa*
Lower glume length (mm)	2·4–3·2	2·0–2·4	1·5–3·0	2·0–3·3	2·3–3·0	1·3–2·2
Upper glume length (mm)	3·7–4·7	4·0–4·6	3·2–4·5	4·0–5·0	3·9–4·4	3·2–4·3
Glume ratio	0·6–0·7	0·5–0·55	0·48–0·67	0·5–0·67	0·57–0·68	0·45–0·6
Lemma length (mm)	5·3–5·6	4·6–5·5	4·5–5·0	5·5–6·2	5·5–6·1	4·7–6·4
Awn length (mm)	3·6–4·3	3·2–4·2	3·5–4·5	3·0–6·0	3·6–4·4	4·0–4·9
Anther length (mm)	0·8–1·0	1·0–1·1	0·6–0·9	1·0–1·3	1·3–1·5	1·0–1·5

of environmental conditions. For example, the longer lemma length of the W. Norfolk hybrid compared with the S. Lancs. hybrid indicates that in the former case *F. rubra* subsp. *litoralis* (lemmas mostly 6·0–7·5 mm) was the likely parent whereas in the latter case *F. nigrescens* (lemmas mostly 5·0–6·5 mm) was involved. On the other hand the Dutch hybrid, probably involving *F. nigrescens*, has lemmas as long as those of the W. Norfolk hybrid. Of the two plants collected at Merioneth (1957 and 1970) one has glabrous and one pubescent leaf-sheaths.

The chromosome number of the W. Norfolk hybrid is, as expected, 2n = 42. The pollen stainability is c. 0·4% and no seed-set has been observed.

Two plants of *Vulpia myuros* × *Festuca diffusa* were synthesized by Barker (1980), and measurements of the diagnostic features were presented by Barker & Stace (1984) (see also Table 4). In all cases the characteristics were very close to those of the wild hybrids (despite the very different *Festuca* parents involved). Pollen was 0% stainable.

CHROMOSOME BEHAVIOUR

Meiotic analysis of the W. Norfolk hybrid (Table 3) showed a slightly lower degree of pairing than the wild hybrids involving *Vulpia bromoides* showed in 1984. A mean of 13·6 bivalents, of which 9·2 were ring bivalents, and a mean chiasma frequency of 24·3 per cell, were obtained. In view of the markedly different results obtained in 1978 and 1984 for the E. Suffolk plant of *F. rubra* × *V. bromoides*, the differences between the *V. bromoides* and *V. myuros* hybrids are probably not significant.

For comparison the results of meiotic analysis of the artificial hybrid *Vulpia myuros* (female) × *Festuca diffusa* are given in Table 3. Pairing affinity in this hybrid is slightly higher than in any of the wild hybrids mentioned above, emphasizing the point that there are probably no significant differences between any of the data.

DISCUSSION

Wild hybrids occur in Britain and the Channel Isles in the following combinations: *Festuca rubra* × *Vulpia fasciculata*, *F. juncifolia* × *V. fasciculata*, *F. rubra* × *V. bromoides*, *F. nigrescens* × *V. bromoides*, *F. rubra* × *V. myuros* and *F. nigrescens* × *V. myuros*. Probably three subspecies (*rubra, arenaria* and *litoralis*) of *F. rubra* are involved. The three species of *Vulpia* represent three ploidy levels (diploid, tetraploid, hexaploid) and two sections of the genus (*Vulpia*, *Monachne*). Two ploidy levels of *Festuca* (hexaploid, octoploid) are involved. Because of the cleistogamous or semi-cleistogamous nature of the *Vulpia* parents, and the small amount of pollen that they produce, all the wild hybrids are probably formed by crosses of male *Festuca* with female *Vulpia*.

Artificial hybrids (Barker & Stace 1982) include a number of the above as well as crosses involving a third (self-incompatible, chasmogamous) section of *Vulpia* (*Loretia*). In the latter case reciprocal hybrids were raised, but in the crosses between *Festuca* and *Vulpia* sections *Vulpia* and *Monachne* hybrids were raised only when the *Vulpia* parent was used as female. Whether this is due to the small amount of *Vulpia* pollen available for crosses, or to unilateral interspecific incompatibility, is unknown.

Elsewhere the only recorded occurrences of × *Festulpia* are *F. nigrescens* × *V. myuros* in Holland, detailed above, and the report by Patzke (1970) of *F. rubra* subvar. *microphylla* × *V. membranacea* found in 1966 by Peter at Suances, Santander, Spain. According to the nomenclature of *Flora Europaea* the latter hybrid is presumably *F. nigrescens* subsp. *microphylla* (St Yves) Markgr.-Dannenb. × *V. fasciculata*. We have not seen the specimen.

The relative rarity of *Festuca* × *Vulpia* crosses in the wild is probably due largely to the cleistogamous or semi-cleistogamous and self-compatible floral biology of the *Vulpia* species in the British Isles, so that stigmas are rarely available to foreign pollen, together with the very small amounts of pollen (often none of it air-borne) produced by these species. The lack of records of hybrids between *F. rubra* and chasmogamous, self-incompatible species of *Vulpia* section *Loretia* in the Mediterranean region is less easily explained. However, both *F. rubra* and suitably experienced field-botanists are much less common there than in north-western Europe.

Festuca rubra × *Vulpia fasciculata* occurs in most sand-dune areas of south-western Britain and the Channel Isles where *V. fasciculata* is common. We have never failed to find it in such places, although the same is not true of similar localities in East Anglia or Jersey. Hybrids involving *V. bromoides* and *V. myuros* are much less certain in occurrence. The much greater regularity of complete cleistogamy (compared with the normal semi-cleistogamy of *V. fasciculata*) in these two species might explain this. The S. Lancs. hybrid of *F. nigrescens* × *V. myuros* was, in fact, found in a population of *V. myuros* exhibiting a high (and very unusual) degree of chasmogamy, with dehiscing anthers and receptive stigmas partially exposed.

In cultivation the hybrids appear not to be very long-lived (a few years only), and not all of them flower every year. These facts might contribute to the rarity of records in the wild. The E. Suffolk locality of *F. rubra* × *V. bromoides* has yielded hybrids on three occasions (1969, 1973, 1976), but it is as likely that, in years when unsuccessful searches were made, the hybrids occurred there in the vegetative state as the locality is especially conducive to hybridization. Moreover the number of hybrids found dropped from ten to one over the eight-year period, and the hybrid found in 1976 (having $2n = 42$) was not an F_1 plant (Stace & Ainscough 1984).

Unfortunately it might not be possible to distinguish the hybrids involving *V. bromoides* from those involving *V. myuros* on all occasions. The best character is the inflorescence shape. Since the only two plants of *F. rubra* × *V. bromoides* with a known chromosome number are hexaploids, it remains a possibility that they are *F. rubra* × *V. myuros* hybrids. However, in both cases the inflorescence is very short, quite unlike the elongated panicles of known natural and artificial hybrids of *F. rubra* × *V. myuros*, and in one case (Leics.) there is no *V. myuros* known in the vicinity.

Similarly, it is very difficult to distinguish hybrids involving *F. rubra* from those involving *F. nigrescens* (the same is also true of those involving *F. juncifolia*). If the hybrid is rhizomatous, obviously *F. rubra* (not *F. nigrescens*) is involved, but the known hybrids of *F. rubra* × *V. myuros* from Merioneth and W. Norfolk are not rhizomatous.

Despite the relative rarity of hybridization, and the high degree of sterility of the hybrids, there remains a considerable degree of genomic homology between species of *Vulpia* and the *Festuca rubra* aggregate. In the hexaploid hybrids involving *V. bromoides* and *V. myuros* (Table 3) more than 14 bivalents were rather regularly observed, and there were often more than 14 ring-bivalents. Therefore both homogenetic (F-F and V-V) and heterogenetic (F-V) pairing, often with chiasmata in both chromosome arms, occurs. Similarly, in the hexaploid derivative of *F. rubra* × *V. fasciculata* reported by Stace & Ainscough (1984), both homogenetic and heterogenetic pairing takes place. The same is also true of artificial hybrids between the diploid *V. sicula* and hexaploid *F. rubra* agg. (Barker & Stace in press). Hence there is genomic homology between *F. rubra* agg. and species of all three sections (*Loretia*, *Monachne*, *Vulpia*) of *Vulpia* investigated.

We interpret the main evolutionary trend in *Vulpia* as being away from a perennial, chasmogamous outbreeder (section *Loretia*) to an annual, cleistogamous inbreeder (section *Vulpia*), the former being derived from a *Festuca*-like ancestor similar in many respects to *F. rubra* agg. Whereas *F. rubra* agg. has developed into a declining polyploid complex, with very few (if any) diploid representatives still extant, *Vulpia* has retained a substantial number of diploids as well as developing tetraploidy and hexaploidy. The apparently 'closed' genetic system of *F. rubra* agg. is, however, alleviated by the retention of its ability not only to hybridize with *Vulpia* but also for its chromosomes to exchange genetic material with those of *Vulpia*. Stace & Ainscough (1984) have demonstrated that this level of genomic homology can result in backcrossing and the introgression of *Vulpia* genes into *F. rubra*, which thus retains a partially 'open' genetic system normally out of the reach of a declining polyploid complex. This is a good illustration of the evolutionary importance of relatively rare hybridization events between superficially dissimilar taxa, even where the primary hybrids are highly sterile.

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Hybridization in the genus *Atriplex* section *Teutliopsis* (Chenopodiaceae)

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ABSTRACT

A study based on experimental hybridization, culture and field work reports the occurrence of *Atriplex* hybrids in the flora of the British Isles, and discusses the taxonomic implications of these findings. The following hybrids were synthesized experimentally: *Atriplex littoralis* × *longipes*, *A. littoralis* × *praecox*, *A. littoralis* × *patula*. Segregation of wild *A. littoralis* × *prostrata* hybrids collected from two localities in W. Norfolk, v.c. 28, was observed in the botanic garden. Some of the segregants were similar in leaf morphology to *A. patula*, and others were identical to the formerly recognized taxon *A. littoralis* var. *serrata*. Evidence is presented that *A. calotheca* (Raf.) Fries, a species endemic to Scandinavia and the Baltic coasts of adjacent countries, did not originate from *A. littoralis* × *A. prostrata* as claimed by G. Turesson. Literature reports of the putative hybrids *A. glabriuscula* × *littoralis* and *A. patula* × *prostrata* in the British Isles are probably wrong.

INTRODUCTION

Section *Teutliopsis* Dum. includes all the native British *Atriplex* species except *A. laciniata* L. The members of this section are morphologically similar, genetically highly variable and phenotypically plastic. Because of this, the recognition of hybrids can be extremely difficult. Without evidence from carefully controlled experimental hybrids, assumptions about hybridization in *Atriplex* can be no more than speculation.

Turesson (1925) produced the first artificial hybrids in *Atriplex*. He used two techniques: one, which he called "free crossing", consisted in surrounding a plant of one species with several plants of another species; the other was to isolate the inflorescences of the parent species together in the same pergamin bag. He used these uncontrolled techniques because, as he stated, ". . . castrations unfortunately cannot be made in the genus *Atriplex* because of technical difficulties . . ." (Turesson 1925). Hulme (1957, 1958), however, succeeded in producing controlled experimental hybrids.

Gustafsson (1972, 1973a, 1973b, 1974) made a large series of carefully controlled experimental hybrids between all the members of the *A. prostrata* group in Scandinavia. He examined the cytology and fertility of natural and artificial hybrids and variation in hybrid offspring. He later (Gustafsson 1976) provided morphological descriptions of the species in this group with notes on the morphology, frequency and distribution of the hybrids in Scandinavia. The Scandinavian representatives of the group include all those found in the British Isles and an additional species, *A. calotheca* (Raf.) Fries, indigenous to the Baltic region. Gustafsson's studies form the basis for understanding this complex as it exists in Britain.

Partially fertile artificial hybrids have been made between species of sections *Teutliopsis* and *Sclerocalymma*, but none have been found in nature (Björkman *et al.* 1969, 1971). Nobs (1976) summarized the results of a number of attempted intersectional crosses (including *A. prostrata* × *A. laciniata* and *A. glabriuscula* × *A. laciniata*) which produced strong F_1 progenies, but these were less than 10% fertile. The other results were highly variable with some crosses yielding a strong F_1 but others producing no seed or only a sub-lethal F_1. None of the crosses, however, was sufficiently fertile to produce a second generation.

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The present study is based on experimental hybridization and culture work in the botanic garden and on field studies in Britain between 1974 and 1978. It examines the crossing relationships between *A. littoralis* and other members of the section *Teutliopsis* occurring in Britain and elsewhere. It reports on segregation in hybrid specimens of the *A. prostrata* group collected in northern and western Scotland and it discusses the taxonomic implications of the results of these studies.

MATERIALS AND METHODS

EXPERIMENTAL HYBRIDS

The technical difficulties of making artificial crosses in *Atriplex* involve: a) the small flower size (c. 1 mm just before anthesis); b) the close proximity of the staminate to the pistillate flowers (both types occur together in tightly compressed glomerules); and c) the ease with which self-pollination can occur in this self-fertile, primarily autogamous group.

Two characteristics of *Atriplex* floral development make experimental crossing possible: the occasional production of isolated axillary pistillate flowers, and the occurrence in some species of a degree of protogyny.

The plants used as female parents in these experiments were all at least slightly protogynous. Some also produced exclusively pistillate flowers in the upper leaf axils. The branches of these plants, all of which would have produced terminal inflorescences, were clipped before the flowers opened. Only two or three branches were left for controlled crossing. The staminate buds, which in normal glomerules occurred immediately above the pistillate ones, were removed with fine forceps. Pollen, freshly collected from mature newly-opened flowers, was applied to the receptive stigmas of the female parent with a no. 000 fine sable hair brush. Each morning the inflorescences were examined before 08:00 hours with a ×14 lens, and successively forming staminate buds removed. After each examination the emerging new stigmas were repeatedly brushed with fresh pollen. The process was continued for about five weeks by which time the first seeds were beginning to ripen and flower formation had ceased. Plants used as female parents were isolated in separate, screened greenhouse cubicles. Emasculated plants, not pollinated, did not develop seed.

By these methods, 35 crosses within section *Teutliopsis* were made, 14 of which produced an F_1 generation. The following species were used: *A. littoralis* L. from England, Scotland, Finland, Norway, Romania and U.S.S.R.; *A. praecox* Hülphers from Scotland and Norway; *A. prostrata* Boucher ex DC. from England; *A. longipes* Drejer from England; *A. glabriuscula* Edmondston from England; *A. calotheca* (Raf.) Fries from Norway and Denmark; *A. patula* L. from England, Hungary and Argentina. The crossing combinations are given in Table 1. In addition, one intersectional cross between *A. littoralis* (Romania) of section *Teutliopsis* and *A. rosea* L. (Romania) of section *Sclerocalymma* was attempted, but no seed was produced.

NATURAL HYBRID SEGREGATION

A. littoralis × A. prostrata

Three plants of this putative hybrid were collected from two localities in Norfolk. Seed was taken from each of these plants and sown separately in sterilized compost. A total of 332 F_2 plants was scored.

A. prostrata Group Hybrid Derivatives

Seeds of putative hybrid plants believed to involve *A. prostrata*, *A. longipes*, *A. glabriuscula* and *A. praecox* from three localities on the northern and western coasts of Scotland were sown in the botanic garden. About 40 plants from each hybrid were raised.

POLLEN AND SEED FERTILITY

Pollen fertility was estimated as the percentage of well-developed pollen grains deeply stainable with trypan blue in lactophenol. From 500 to 1,500 grains were counted for each individual. Seed fertility was estimated as percentage of seeds germinating. In addition to pollen and seed fertility, seed production was examined in the hybrids and hybrid progeny.

Voucher specimens of experimental hybrids, putative hybrids and hybrid segregants were deposited in **MANCH**.

TABLE 1. ATTEMPTED CROSSES WITH *A. LITTORALIS*
Origin of seed is given in parentheses after the species.

Female parent		Male parent	No. of attempted crosses	No. of crosses producing an F_1	Total no. of F_1 plants
Diploid $2n=18$		Diploid $2n=18$			
A. littoralis (England)	×	*A. prostrata* (England)	1	0	0
A. littoralis (U.S.S.R.)	×	*A. prostrata* (England)	1	0	0
A. littoralis (Finland)	×	*A. glabriuscula* (England)	1	0	0
A. littoralis (England)	×	*A. longipes* (England)	1	0	0
A. longipes (England)	×	*A. littoralis* (England)	2	0	0
A. littoralis (Finland)	×	*A. longipes* (England)	4	4	45
A. littoralis (Finland)	×	*A. praecox* (Scotland)	2	2	9
A. praecox (Scotland)	×	*A. littoralis* (Norway)	4	0	0
A. littoralis (Romania)	×	*A. calotheca* (Norway)	1	0	0
A. littoralis (U.S.S.R.)	×	*A. calotheca* (Norway)	7	0	0
A. littoralis (U.S.S.R.)	×	*A. calotheca* (Denmark)	2	0	0
A. praecox (Norway)	×	*A. littoralis* (England)	1	0	0
Diploid $2n=18$		Tetraploid $2n=36$			
A. littoralis (Romania)	×	*A. patula* (England)	1	1	13
A. littoralis (U.S.S.R.)	×	*A. patula* (Argentina)	1	1	32
A. littoralis (U.S.S.R.)	×	*A. patula* (England)	5	5	91
A. littoralis (U.S.S.R.)	×	*A. patula* (Hungary)	1	1	40

RESULTS AND DISCUSSION

EXPERIMENTAL HYBRIDS

A. littoralis × A. prostrata Group

The results of attempts to cross diploid *A. littoralis* with members of the diploid *A. prostrata* group are summarized in Table 1. The pollen fertility of the species and hybrids is compared in Table 2.

Although *A. littoralis* hybridizes with *A. prostrata* in nature, as discussed below, attempts to obtain artificial hybrids were unsuccessful. In all attempted crosses, however, the *A. prostrata* parents were inland ruderal biotypes. The natural hybrids involved only the coastal halophytic biotypes.

TABLE 2. POLLEN FERTILITY (% STAINABLE GRAINS) IN SPECIES, NATURAL HYBRID PROGENY, AND EXPERIMENTAL HYBRIDS
N=number of plants sampled

	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100	N
Species											
A. littoralis	–	–	–	–	–	–	–	–	1	3	4
A. patula	–	–	–	–	–	–	–	–	–	1	1
A. praecox	–	–	–	–	–	–	–	–	–	1	1
Wild hybrid segregants											
A. littoralis × A. prostrata F_2	–	–	–	1	1	3	1	3	3	4	16
Experimental hybrids											
A. littoralis × A. longipes F_1	–	–	5	8	7	5	1	–	–	–	26
A. littoralis × A. praecox F_1	–	–	–	1	4	–	–	–	–	–	5
A. littoralis × A. patula F_1	4	–	–	–	–	–	–	–	–	–	4
A. littoralis × A. patula F_2	1	1	2	2	1	–	–	–	–	–	7
A. littoralis × A. patula F_3	–	–	–	–	–	–	–	4	4	–	8

TABLE 3. *A. LITTORALIS* × *A. PATULA*: SEQUENCE OF PLANTS CULTIVATED 1975–1978 FROM A SINGLE CROSS

One cross yielding 40 hybrid plants	Number	%
F_1		
Plants cultivated to maturity	36	90
Plants surviving to produce some seed	12	33
Total seed production of all seed-bearing plants	35	
Seeds planted	35	100
F_2		
Seeds germinating	17	49
Plants surviving to produce some seed	17	100
Total seed production of all seed-bearing plants	c.900	
Seeds planted	20	2
F_3		
Seeds germinating	13	65

Attempts to synthesize the hybrid *A. littoralis* × *glabriuscula* were also unsuccessful.

A. littoralis was successfully crossed with *A. longipes* only when Finnish *A. littoralis* was used as the female parent and English *A. longipes* as the male parent. Reciprocal crosses using English plants only were unsuccessful. The F_1 hybrids were morphologically intermediate between the parent species and distinctly different from *A. littoralis* × *prostrata* hybrids.

A. littoralis (female) was crossed with *A. praecox* (male) and produced morphologically intermediate hybrids. Four attempts at the reciprocal cross failed. Crosses using two strains of *A. praecox* (one from Norway and one from Scotland) as the female parent produced many well-formed seeds but none of them germinated.

Unsuccessful attempts were made to cross *A. littoralis* with *A. calotheca*, a member of the *A. prostrata* group almost entirely restricted to the coasts of Scandinavia. This cross was of particular interest because of Turesson's (1925) belief, based on experimental findings, that *A. calotheca* itself originated from the hybrid *A. littoralis* × *A. prostrata.*

Except for *A. littoralis* × *prostrata*, discussed below, no hybrids between *A. littoralis* and members of the *A. prostrata* group have been found in nature.

A. littoralis × *A. patula Crosses*

All crosses between diploid *A. littoralis* (female) and tetraploid *A. patula* (male) were successful and 176 triploid F_1 plants were obtained (Table 1). In cultivation, the F_1 hybrids were large (up to

TABLE 4. *A. LITTORALIS* × *A. PATULA*: SUMMARY OF CULTIVATED PLANTS AND FERTILITY CHANGES IN THREE GENERATIONS

Total no. of crosses	8
Total no. F_1 plants produced	176
Total no. F_1 plants grown to maturity	140
Total no. F_1 plants producing seed	18
% seed-bearing F_1 plants	13
Range of seeds per F_1 plant	(0–) 1–8 (–32)
Total no. of F_2 plants grown to maturity	42
Total no. of F_2 plants producing seed	33
% seed-bearing F_2 plants	79
Range of seeds per F_2 plant	(0–) 15–175 (–c.300)
Total no. of F_3 plants grown to maturity	11
Total no. of F_3 plants producing seed	9
% seed-bearing F_3 plants	82
Range of seeds per F_3 plant	(0–) c.300–c.1000 (–c.2000)

TABLE 5. HYBRID DERIVATIVES IN THE *A. PROSTRATA* GROUP. SUMMARY OF CULTIVATION RESULTS

Hybrid	Locality	Progeny
A. glabriuscula × *praecox*	Tongue, v.c. 108	One of the progeny had bracteoles with stalks suggesting *A. longipes* may be involved
A. × *kattegatensis* (*A. longipes* × *prostrata*)	Ullapool, v.c. 105	No segregation. Plants very similar to each other
A. glabriuscula × *longipes*	Oban, v.c. 98	Parental characters apparent in several of the progeny, i.e., long-stalked, very thick bracteoles

1.5 m high) and robust, but mostly sterile. Pollen fertility varied from 5% to 9% stainable grains and the seed set varied from one to eight seeds per plant (to 32 in one plant). Only 13% of the plants produced any seed. Hulme (1957) examined the cytology of this hybrid and reported irregular meiosis: bivalents and univalents occurred and trivalents were frequent; tetrads contained from three to five units that varied considerably in size. In later generations (Tables 3 and 4), pollen fertility, seed production and fertility increased but this was not matched by an increase in vegetative vigour. The F_2 and F_3 plants were weak and morphologically distorted and probably would not have survived outside of greenhouse cultivation.

The experimental F_1 hybrid is readily made and vigorous. Therefore, one might expect the wild hybrid to be frequent in nature. This, however, is not the case. Despite careful searches in several coastal localities where *A. patula* and *A. littoralis* were observed growing together in disturbed ground, only one putative hybrid population was found.

The wild hybrids were much smaller than the experimental hybrids, with shorter leaves and much more condensed inflorescences. A characteristic feature of this hybrid was the presence on most inflorescences of one or two expanded, well-formed, fertile bracteoles that stood out amongst a mass of compressed, mis-shapen, sterile bracteoles.

NATURAL HYBRIDS

A. prostrata Group

Segregation in Putative Hybrids. Segregation in the putative hybrid offspring was not clear. The wild hybrids seemed to be hybrid derivatives rather than first generation hybrids and it was not obvious which of the four species in this group were involved. Their progeny often showed the same characters as the parents, only in different combinations. Characters derived from the original parent species were not seen together in any single offspring but could sometimes be observed in several plants derived from one hybrid. The development of stalked bracteoles on several plants indicated, for example, that *A. longipes* was involved. One progeny from Ullapool plants showed little variation and compared well with a relatively stable variant of *A. longipes* × *A. prostrata* that is common on the western coasts of Sweden. The results of cultivation are summarized in Table 5.

Effectiveness of Cultivation as a Technique. Previous authors have commented on the problems of using cultivation to determine the parentage of putative hybrids in the *A. prostrata* group. Turesson (1925), who raised up to 200 individuals from putative hybrids in the group, observed that segregation often took place only as regards subtle, small characters that allowed no conclusion to be drawn as to the parental species. Gustafsson (1973a) noted that most of the genes governing the taxonomic characters in this group, even those conditioning the different characters of the bracteoles, are inherited unlinked.

The following practical reasons limited the use of cultivation to investigate the parentage of wild hybrids in this group. Firstly, the progeny of hybrids were often extremely luxuriant, producing tangled masses of branches up to 1 m long, and requiring large areas for cultivation. Secondly, in this group it was essential to grow all the plants to maturity to study the characters of the bracteoles. These, however, were very easily lost from the plants. Indoors, the branches of adjacent plants became tangled and most of the bracteoles fell off in separating them; outdoors, birds removed most of the bracteoles.

TABLE 6. *ATRIPLEX LITTORALIS* × *A. PROSTRATA* NATURAL HYBRIDS, F_2 SEGREGATION AND SEED GERMINATION

Locality	% seeds germinating	No. of plants examined	No. of *prostrata* types	No. of intermediate types	No. of *littoralis* types	No. of sickly plants
Wolferton, Norfolk						
76–24A	86.5	82	10	61	5	6
76–24B	86.1	46	4	36	6	0
Burnham Deepdale, Norfolk						
76–20	50.7	204	56	85	7	56

Occurrence in the British Isles. A. longipes × *A. prostrata* is one of the most frequent hybrids on the coasts of Britain. A true-breeding variant is known from northern and north-western Scotland and Shetland where it occupies a habitat uncolonized by either of the parent species. Gustafsson (1973b) has made artificial hybrids between this variant and the following species: *A. longipes*, *A. praecox* and *A. prostrata*, but these hybrids have not been reported from nature. Field studies indicate that other hybrids and hybrid derivatives involving *A. longipes* are very frequent in Britain and of key importance in understanding variation in the *A. prostrata* group here.

A. littoralis × *A. prostrata*

Segregation in Putative Hybrids. A. littoralis × *A. prostrata* putative F_1 hybrids collected in nature were relatively fertile. About 70–80% of the bracteoles contained well-developed seed. Both large-brown and small-black seed morphs were frequent in the same plant and germination of both morphs was high (80 to 90%). Pollen fertility of F_2 plants is given in Table 2, and segregation is summarized in Table 6.

From 3% to 13% of the plants segregated toward *A. littoralis*, 9% to 27% toward *A. prostrata* and from 42% to 78% of the segregants were morphologically intermediate. The percentage of sickly and distorted plants ranged from 0% to 27%. In all three hybrids the number of progeny that segregated back toward the parental types left no doubt as to the parentage of the hybrid. Pollen fertility varied from less than 40% to more than 90%, but in 56% of the plants the fertility values were less than 80%.

In contrast to hybrid segregation in the *A. prostrata* group (Gustafsson 1973b), morphological segregation towards the parent species appears to be combined with the restoration of male fertility. With few exceptions, plants segregating toward parental types, including the *serrata* leaf form of *A. littoralis*, had pollen with well-formed, equal-sized grains and fertility values of over 90%. Morphologically intermediate plants showed considerable variation both in equality of grain size and stainability. Most of the plants in this category had pollen grains of unequal size with the amount of stained pollen ranging from 40% to 74%.

Segregants showing a wide range of character combinations occurred in cultivation and were observed growing with F_1 plants in the field. Many of the segregants were largely sterile and often weak-stemmed, but some were vegetatively very vigorous. The following three variants appeared in cultivation and were later found to be common where the hybrids occurred in nature:

1. *Patula*-leaf form (Fig. 1B). Plants with leaves like *A. patula* that possess the falcate basal lobes so characteristic of this species.
2. *Serrata*-leaf form (Fig. 1A). Plants with markedly sinuate-dentate leaves like extremes of plants formerly called *A. littoralis* var. *serrata*.
3. Gigantic form. Plants up to 1 m (2 m in cultivation) high with thick stems and gigantic leaves with ovate-lanceolate, irregularly-lobed laminae up to 15 cm long and 4 cm wide.

Occurrence in the British Isles. A. littoralis and *A. prostrata* commonly occur together. *A. littoralis* is frequently a dominant, forming dense stands, whilst *A. prostrata* is an associated subdominant. The two species are reproductively isolated from each other by differences in flowering time. *A. littoralis* flowers earlier. Cropping the terminal inflorescence in this species induces re-flowering in the new branches that arise. The later-flowering branches overlap in flowering time with *A. prostrata*. In cultivation, when the terminal inflorescences are removed, the axillary flowers that

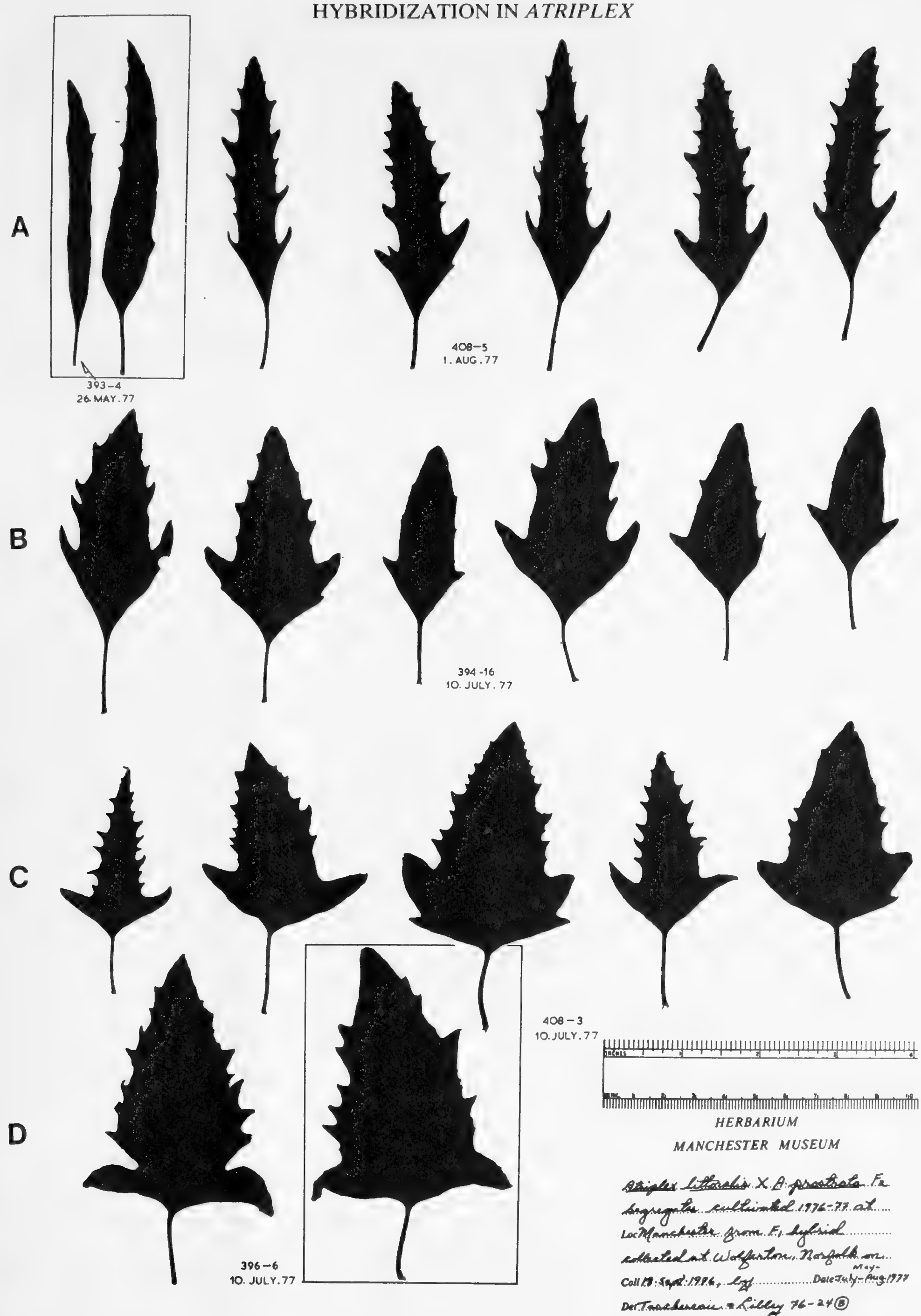

FIGURE 1. Leaf morphology of a variety of F_2 segregants cultivated from the wild hybrid *Atriplex littoralis* × *A. prostrata*. A, *A. littoralis* types (boxed) and leaves similar to those of the formerly recognized taxon *A. littoralis* var. *serrata*. B, Leaves morphologically ± identical to those of *A. patula*. C, Various intermediate leaf forms. D, *A. prostrata* types.

form are largely pistillate. In nature, this phenomenon coupled with protogyny would further favour out-crossing in *A. littoralis*. The hybrid *A. littoralis* × *A. prostrata* is known from the eastern and western coasts of England in v.cc. 28, 58, 60, and 66. It can be expected in disturbed habitats where the parent species are present in abundance: banks of estuaries recently dredged, earthen sea walls less than three years old, and salt marshes disturbed by rabbit cropping.

Resemblance of Hybrid Segregants to A. patula. In cultivation, numerous F_2 segregants of *A. littoralis* × *A. prostrata* were identical in leaf morphology to *A. patula*. Plants with this leaf morphology (Fig. 1B) were later found to occur in populations of wild hybrids in Britain. The plants bear a close resemblance to *A. patula* and in the vegetative state are very difficult to distinguish from that species. I have seen more than one sheet of the hybrid in British herbaria labelled "*A. patula*".

The mature hybrid plants may be readily distinguished from *A. patula* by the bracteoles. In the hybrid these are spongy-thick while in *A. patula* they are herbaceous and thin. Unlike the hybrid, *A. patula* does not grow in the same habitat as *A. littoralis*. The hybrid tends to be more succulent than *A. patula* and the lower leaves and branches on the hybrid are commonly alternate while in *A. patula* they tend to be opposite to subopposite.

ORIGIN OF SERRATE-LEAVED VARIANTS OF *A. LITTORALIS*

Most populations of *A. littoralis* have some plants with leaves that exhibit a degree of toothing on their margins. The development of marginal teeth varies from leaves that have only a few short irregular teeth in their distal portions to leaves that are coarsely and irregularly sinuate-dentate throughout and may have pronounced basal lobes. In their extreme form, the serrate-leaved variants of *A. littoralis* are highly distinctive plants. Hudson (1762), Linnaeus (1771) and pre-Linnean authors such as Petiver (1713) recognized such variants as distinct species.

For excellent examples, see the following sheets in the British herbarium **BM**: v.c. 15, Sandwich Bay, *R. Meinertzhagen*, 10.VIII.32; Pegwell Bay, *A. J. Wilmott*, 20/9/1912; v.c. 18, Bank of Thames at Tilbury Fort. There are also specimens from v.cc. 13, 16, 18. In **LD** there are specimens of this variant collected from Borgholm, Öland, Sweden by different collectors in successive years: 1874 by *C. F. Elmqvist*; 1912 by *B. J. Holmgren*; June 1932 by *A. Vilke* and July 1932 by *H. Hylander*.

The repeated appearance of this extreme variant as well as less extreme plants amongst the F_2 segregants of *A. littoralis* × *A. prostrata* suggests that the serrate-leaved plants of *A. littoralis* originated through hybridization with *A. prostrata*. However, cultivation experiments have demonstrated that the expression of this leaf character is dependent on relatively high nitrogen or optimum salt concentration in the soil (Ahmad in Taschereau 1979). For example, 50 mM NaCl in the nutrient led to the development of leaves with marked serrations but increasing the salt concentration to 400 mM NaCl produced plants with entire leaves. Control plants, grown in diluted standard nutrient without salt, produced leaves with a few short teeth such as are commonly found in *A. littoralis* populations.

Moss & Wilmott (1914) and various other authors have treated plants with more or less serrate leaves as a taxonomic variety: *A. littoralis* L. var. *serrata* (Huds.) S. F. Gray. Such plants occur in most populations of *A. littoralis* and the degree of toothing varies greatly within and between individual plants. Owing to this and the environmental component of the variation and the fact that there is no consistent correlation with bracteole morphology, it is better to recognize this variation in a description rather than by means of a formal epithet.

ORIGIN OF *A. CALOTHECA*

Turesson (1925) stated that *Atriplex calotheca* probably originated from the cross *A. littoralis* × *A. prostrata*. He based this on presumed artificial hybrids morphologically similar to *A. calotheca*. The pollen fertility of these plants was low and a great many of the bracteoles empty. Turesson suggested that the laciniate-leaved individuals he obtained originated from crosses of *A. prostrata* with the serrate-leaved variant of *A. littoralis*.

I was unable to find specimens in **LD** or **S** of the plants Turesson assumed represented the hybrid *A. littoralis* × *A. prostrata*. The photograph, however, in Fig. 8 and the drawings in Fig. 9 of Turesson's (1925) paper as well as the description are of specimens that are clearly identical to *A. calotheca*. They bear no resemblance to the plants I have described as *A. littoralis* × *A. prostrata*. The plants that Turesson described as this hybrid may have arisen by segregation from *A. prostrata* plants that were themselves of hybrid origin involving *A. calotheca*. The following facts support this explanation. Firstly, hybrid plants in the *A. prostrata* group can resemble one or other of the parents (Gustafsson 1973a). When the seeds from such plants are cultivated, the effects of hybridization usually become evident in some of the progeny. Secondly, Turesson did not succeed in emasculating the parent plants, and in his attempt to obtain hybrids between *A. prostrata* and *A. littoralis* by 'free crossing', he harvested only the *A. prostrata* plants. Thirdly, introgressive hybridization between *A. prostrata* and *A. calotheca* is a common phenomenon in western Scandinavia and extensive hybrid swarms are frequent throughout the entire range of *A. calotheca* (Gustafsson 1976). The exact geographical origin of the plants Turesson used as parents is unknown, but hybrids between *A. prostrata* and *A. calotheca* are common at the sites Turesson investigated (M. Gustafsson pers. comm. 1975).

ERRONEOUS AND UNCONFIRMED REPORTS OF HYBRIDS

The identification of hybrid material in *Atriplex*, without evidence from experimental studies, is unsatisfactory. The following reports, all unconfirmed, are probably wrong.

A. glabriuscula × *A. littoralis*

Jones (1975) reported this hybrid based on plants she observed at Gibraltar Point, v.c. 54. My attempts to synthesize it were unsuccessful. Jones's report is probably incorrect because *A. glabriuscula*, one of the putative parents, is absent from Gibraltar Point. I searched carefully for it there in 1975 and the species later proved to be entirely absent from the coasts of Yorkshire, Lincolnshire and Norfolk, v.cc. 61, 54, 28, 27 (Taschereau 1979). The description of Jones's putative hybrid agrees with that of *A. littoralis* × *A. prostrata* and both of the parent species of this hybrid are present at Gibraltar Point. Jones (pers. comm. 1975) was herself not at all certain of her identification and was not aware of the existence of *A. littoralis* × *A. prostrata.*

A. patula × *A. prostrata*

Jones (1975) reported this hybrid as "very doubtfully recorded from v.cc. 3, 10 and 14 and from Germany on the basis of apparently intermediate specimens". *Atriplex patula* and *A. prostrata* very frequently grow together, often with their branches intertwined, in disturbed ground on vacant lots and demolished building sites throughout the British Isles. The hybrid was synthesized by Hulme (1957, 1958) who reported that the plants did not resemble any wild plants she had seen. Although the wild hybrid may yet be found in Britain, Jones's report is probably wrong. Despite numerous searches for the hybrid in situations where it might be expected, I have not found it. All specimens of apparently intermediate morphology, on cultivation, proved to be one of the species, usually *A. prostrata.* The basis for at least some reports of plants intermediate between *A. patula* and *A. prostrata* is probably the hybrid *A. longipes* × *prostrata*, only recently reported to occur inland in waste places (Taschereau 1985). Derivatives of this hybrid frequently have leaves with obtuse to cuneate bases that make them appear intermediate between *A. patula* and *A. prostrata*, previously the only taxa known from this habitat.

A. glabriuscula × *A. praecox*

Putative hybrids between *A. glabriuscula* and *A. praecox*, reported from Tongue, v.c. 108 and Ullapool, v.c. 105 (Taschereau 1977), remain unconfirmed. Plants grown from seed taken from these specimens yielded a range of variants (Table 5), none of which showed a clear segregation toward either of the putative parents. Other reports of this hybrid (Taschereau 1985) are based on plants clearly intermediate with small leaves morphologically identical to those of *A. praecox* and with bracteoles and seeds morphologically like those of *A. glabriuscula.*

A. glabriuscula × *A. prostrata*

This hybrid is not as common in the British Isles as Moss & Wilmott (1914) believed and as suggested by Jones (1975) who stated that intermediates between *A. glabriuscula* and *A. prostrata* "appear to be common in the British Isles where the two species are in contact. This occurs when weedy habitats are introduced into maritime areas by landslides or the building of sea-defences etc." Specimens I examined in **BM** identified by A. J. Wilmott as this hybrid were variants of *A. glabriuscula.*

ACKNOWLEDGMENTS

Barbara Hulme's important pioneer experimental hybridization work, except for a brief note, remains unpublished. From her thesis, I obtained much valuable information. I am grateful to her for allowing me to copy it and for her hospitality and help during my visit. I gratefully acknowledge the assistance and hospitality of Mats Gustafsson during my visits to Sweden and I am grateful to Richard P. Libbey, with whom I found the first wild hybrids in Britain.

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Further notes on the flora of Bedfordshire

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ABSTRACT

Vascular plant records from Bedfordshire are updated post-1969, and further notes are added on some species. Notes are given on the status, native or otherwise, of many species, including the status in Britain of *Petrorhagia prolifera* (L.) P. W. Ball & Heywood and *Melampyrum arvense* L.

INTRODUCTION

The *Flora of Bedfordshire* (Dony 1953) was the result of 18 years of field study. It has since been supplemented by a list of additional records, with notes on changes in the flora (Dony 1969), and by the publication of the *Bedfordshire plant atlas* (Dony 1976) which showed the distribution of 800 species on a tetrad basis. One of us (J.G.D.) has recently relinquished the B.S.B.I. recordership of vascular plants in the county (v.c. 30) after 40 years. His successor, C. R. Boon, has been an active co-worker in recent years. It would now seem to be an appropriate time to make a further appraisal of the natural vegetation and flora of the county. Since 1969 there have been no important changes in the boundary of the administrative county. Events of historic interest have been the presentation to Luton Museum (**LTN**) of the previously missing sixth volume of Charles Abbot's herbarium and his *Flora Selecta*, a smaller herbarium in four volumes which, unlike his main herbarium, has some of the specimens localized. The Museum has also received ten volumes of excellent drawings of plants made by Caroline Gaye (1804–1883). The drawings are all localized and dated, so providing the first evidence of the occurrence of some plant species in the county.

Since 1969 there have inevitably been many changes in habitat. The most unfortunate has been the loss of the rich water-meadows at Eaton Socon, Habitat Study 14a (Dony 1953), which have been covered with imported topsoil and converted into an amenity area. Improvements to the River Ouse, to make it navigable once more as far as Bedford, have had an adverse effect on its vegetation. Flitwick Moor, still a very important site when Habitat Studies 38–40 (Dony 1953) were made 36 years ago, continues to dry out notwithstanding the efforts of the Bedfordshire and Huntingdonshire Wildlife Trust, which now owns or manages 21 Bedfordshire reserves, to delay this. Two rich ancient woodlands were clear-felled and turned over to arable cultivation in 1973 – "plant a tree year" – but fortunately all the other, too few, important woods remain little changed. The same is true of the chalk downland, the county's most distinctive natural feature. Barton Hill, Habitat Study 60 (Dony 1953), has become the second Bedfordshire National Nature Reserve.

CHANGES IN THE NATIVE FLORA

Needless to say, some plant species may be presumed to have become extinct in the county during the last 30 years, although there is always a hope that they might return, even if not to their previously known site. *Potentilla palustris* (L.) Scop., *Menyanthes trifoliata* L., *Stellaria palustris* Retz and *Dactylorhiza maculata* (L.) Soó have not been seen at their last remaining station, Flitwick Moor, for over 20 years and it is as long since *Sium latifolium* L. was seen by the River Ouse, where it once seemed to be abundant. *Orobanche rapum-genistae* Thuill. had been apparently well established at Rowney Warren, at least since Caroline Gaye drew it from there in 1832, but *Cytisus scoparius* (L.) Link on which it was parasitic failed to survive the severe winter of

1962–3. *C. scoparius* has now returned, but without the broomrape. Otherwise, the ten species (Dony 1953, p. 139) that give a distinctiveness to the county's natural vegetation are unchanged in their abundance, with the exception of *Carum carvi* L., not seen since 1967, and *Bunium bulbocastanum* L., a particularly notable Bedfordshire plant species. This has diminished mainly on account of the continued growth of Luton and Dunstable rather than because of its absence now as a weed of arable land. It is, however, still common within a limited area, giving no immediate cause for concern for its future.

THE ALIEN FLORA

Most of the species added below are of alien origin. During the period 1953–1969 an additional 200 alien species were accounted for (Dony 1969), but in the subsequent period of equal length the number to be added is less than half of this. There are two main reasons:
(a) Much of the alien flora of Bedfordshire has in the past consisted of plants introduced with wool shoddy, which was used extensively on sandy soils devoted to market gardening, now a diminishing agricultural practice in the county. Few of the remaining market gardeners now use shoddy, which in any case is not so readily available. It is also more costly than before as it is now delivered by road instead of rail. Its diminishing use has, however, shown that wool aliens may continue to occur in fields for as long as eight years after the application of shoddy.
(b) Changes in local government in 1974 allowed the collection of refuse to remain the responsibility of district councils but its disposal that of county councils. In Bedfordshire there are now only three relatively large refuse disposal sites instead of eight. The disposal is by a new method described as 'earth filling', which reduces plant growth on the site. Nevertheless, plants of foreign origin, mainly bird seed aliens, may occur.

At the same time, fewer visits have been made to the county since 1969 by botanists resident elsewhere. Until his death in 1976, J. E. Lousley came annually to study wool aliens, which also brought visits from H. J. M. Bowen, E. J. Clement, C. G. Hanson, J. L. Mason and T. B. Ryves. Longer, valuable visits were made each year until 1974 by P. M. Benoit, and E. Milne-Redhead returned to a county of his wartime residence to study its Black Poplars. Other records were made by A. C. Leslie and C. A. Stace.

LIST OF SPECIES

Listed below are species additional to the flora of Bedfordshire since 1969, together with notes on the extension of range of some rarer species. Notes are also added giving additional information for some species to that given in the *Flora of Bedfordshire* (Dony 1953).

The nomenclature and sequence of families follow *Flora Europaea*. The genera and species are listed in alphabetical order within families. Standard herbarium abbreviations are used. '!' after a station indicates that the taxon has been seen there by one or both of the authors and after a person's name indicates that it is a joint record with one or both of the authors. The stations given for the records are in the part of v.c. 30 now in the administrative county of Bedfordshire, except when given in the form, e.g. v.c. 24 [Beds.], which represents a station in v.c. 24 but now in the administrative county of Bedfordshire. This form is used to indicate similar boundary changes. Tetrad references (e.g. 02B) are those used in *Bedfordshire plant atlas* (Dony 1976).

Pteridaceae

Pteris cretica L.: garden wall, Luton, 02B, 1981 (**LTN**), *H. B. Souster*!

Aspidiaceae

Gymnocarpium dryopteris (L.) Newm.: railway wall, Radwell, 05D, 1972 (**LTN**). Second record. This is one of a number of species found in a similar habitat at Leagrave in 1950 (Dony 1953, p. 197), but only *Cystopteris fragilis* (L.) Bernh. survived when the wall was reconstructed.
Polystichum falcatum (L.f.) Diels: in basement of house, Dunstable, 02B, 1982, *J. Schneider*.
P. setiferum (Forssk.) Woynar: Holcot Wood, 04K, 1976 (**LTN**).

Azollaceae

Azolla filiculoides Lam. This has appeared spontaneously in some sites, e.g. at Hatch, 14N, 1981, but in no case becoming established.

Salicaceae

Populus nigra L. The account of this species given in Dony (1953) is misleading but, thanks largely to the fieldwork done by E. Milne-Redhead, it is now known in 21 tetrads – but shows no simple distribution pattern.

Salix pentandra L.: meadow, Milton Bryan, 93Q, 1978 (**LTN**). Second record.

Polygonaceae

Reynoutria sachalinensis (F. Schmidt) Nakai: derelict railway station, Willington, 15A, 1973 (**LTN**).

Rumex conglomeratus Murr. × *R. crispus* L. (*R.* × *schulzei* Hausskn.): meadow, Langford, 14V, 1972 (**LTN**), *P. M. Benoit*!

R. conglomeratus Murr. × *R. obtusifolius* L. (*R.* × *abortivus* Ruhmer.): meadow, Langford, 14V, 1972 (**LTN**), *P. M. Benoit*!

Chenopodiaceae

Atriplex muelleri Benth.: Beeston, 14U, 1950 (**LTN, RNG**), *J. E. Lousley*!; Maulden, 03N, 1976, *E. J. Clement & T. B. Ryves*! Wool alien.

Chenopodium capitatum (L.) Aschers.: spontaneously in garden, Stevington!, 95Y, 1980 (**LTN**), *Mrs Robinson*. Only previous record, 1950.

C. glaucum L.: arable field subject to periodic flooding, Shefford, 13P, 1979 (**LTN**). This has appeared regularly for six years. Last record, unconfirmed, c. 1906.

C. nitrariacum F. v. Muell.: Flitton, 03M, 1979 (**LTN**), det. E. J. Clement. Wool alien.

Kochia scoparia (L.) Schrader var. *subvillosa* Moq.: Maulden, 03N, 1967 (**LTN**). Wool alien.

Amaranthaceae

Amaranthus albus L.: Maulden, 03I, 1976 (**LTN**), det. J. P. M. Brenan. Wool alien.

A. cruentus L.: landfill site, Sundon, 02J, 1985 (**LTN**), det. E. J. Clement. Bird seed alien.

A. deflexus L.: Maulden, 03N, 1969 (**LTN**). Wool alien.

Phytolaccaceae

Phytolacca acinosa Roxb.: waste ground, Aspley Guise, 93H, 1981 (**LTN**), *J. Morris*!

Portulacaceae

Montia sibirica (L.) Howell: well established, Bedford Cemetery, 05K, 1985 (**LTN**), *C. R. Boon*! The only previous record was as a garden weed, c.1950.

Caryophyllaceae

Petrorhagia prolifera (L.) P. W. Ball & Heywood: south-facing bank and track of dismantled railway, Potton, 24E, 1974 (**LTN**), det. J. R. Akeroyd. This has been constant in its population here for twelve years and it cannot be considered to be a casual. There are records of it, or a closely allied species, from West Norfolk, v.c. 28, causing us to wonder if this species is, like *P. nanteuilii* (Burnat) P. W. Ball & Heywood, a native species in southern England.

Ranunculaceae

Ranunculus lingua L.: Harlington!, 03F, 1983 (**LTN**), *L. G. Adams*; R. Ouse, Sharnbrook!, 05E, 1983, Bedfordshire Natural History Society Field Meeting. These are the first records for 100 years of a species doubtfully native in the county.

Papaveraceae

Fumaria capreolata L.: waste ground, Stanbridgeford!, 92G, 1984 (**LTN**), *B. M. Inns*, conf. P. M. Benoit. A casual.

F. densiflora DC. × *F. officinalis* L. subsp. *officinalis*: Dunstable, 02A, 1972, P. M. Benoit. For a description of this hybrid see Stace (1975, p. 135).

F. muralis Koch subsp. *boraei* (Jord.) Pugsley: arable field, Pavenham, 95X, 1972 (**LTN**), *P. M. Benoit*!. A casual.

Cruciferae

Eruca vesicaria (L.) Cav.: Bedford R.D.C. refuse tip, 05F, 1970 (**LTN**). A casual.

Isatis tinctoria L.: spontaneously in garden, Oakley!, 05C, 1970 (**LTN**), *Mrs Smart*. The last certain record was in 1695.

Neslia paniculata (L.) Desv.: Bedford R.D.C. refuse tip, 05F, 1971 (**LTN**). A bird seed alien, previously recorded in 1876.

Crassulaceae

Sedum dasyphyllum L.: wall of mill, Eaton Socon, 15U, v.c. 30 [Cambs.], 1967, but no longer there; wall, Flitwick Manor, 03H, 1975 (**LTN**).

Saxifragaceae

Chrysosplenium alternifolium L. This, perhaps the most surprising native species claimed for Bedfordshire, is based on correctly named specimens in two herbaria compiled by William Crouch (1818–1846) and labelled "Lidlington, May 1844, W. Crouch". Crouch was aware of the closely allied *C. oppositifolium* L. represented by two further specimens correctly named and labelled "Eversholt, May 1843, W. Crouch". The smaller of these herbaria has 33 specimens from counties other than Bedfordshire, the names of the collectors being added. Ten were from Caroline Gaye (1804–1883), who lived five km from Crouch when not away from home as a governess, but the almost 800 vascular plants she drew included only *C. oppositifolium*. Although some doubt must remain with regard to the validity of the *C. alternifolium* record, it is based on apparently sound evidence.

Grossulariaceae

Ribes aureum Pursh: chalkpit, Houghton Regis, 02B, 1976 (**LTN**). Of garden origin, but well established and increasing.

Rosaceae

Cotoneaster multiflorus Bunge: Bison Hill, Whipsnade, 91Z, 1981 (**LTN**), det. E. J. Clement. Remote from houses.

Prunus cerasus L.: edge of wood, Stopsley, 12C, 1983 (**LTN**). The first certain record, see Dony (1953, p. 260).

Rosa rubiginosa L.: Home Wood!, 14N, 1971 (**LTN**), *N. Dawson*.

Sorbus hupehensis Schneid.: Speedwell Farm, Woburn, 93K, 1981 (**LTN**). Remote, with no evidence of being planted.

S. torminalis (L.) Crantz: Maulden Wood, 03V, 1969 (**LTN**); Home Wood, 14N, 1972; Palmers Wood, 14H, 1973. The first records.

Leguminosae

Cicer arietinum L.: Bedford R.D.C. refuse tip, 05F, 1971 (**LTN**). Bird seed alien.

Coronilla scorpioides (L.) Koch: Flitwick, 03G, 1976 (**LTN**), *E. J. Clement & T. B. Ryves*. Wool alien.

Cytisus striatus (Hill) Rothm.: bank of M1 Motorway!, 03C, 1977 (**LTN**), *C. A. Stace*. Originally planted, but now well established.

Hedysarum glomeratum F. G. Dietrich: Flitwick, 03G, 1978 (**LTN**), det. E. J. Clement. Wool alien.

Lathyrus grandiflorus Sibth. & Sm.: gravel pit, Cople!, 14E, 1981 (**LTN**), *T. C. E. Wells*. Garden origin.

Medicago scutellata (L.) Miller: Flitwick, 03G, 1985 (**LTN**), *C. G. Hanson & B. S. Wurzell*, det. E. J. Clement. Wool alien.

Psoralea bituminosa L.: Flitton, 03T, 1981 (**LTN**), det. D. E. Coombe. Wool alien.

Trifolium lappaceum L.: Maulden, 03N, 1968 (**LTN**). Wool alien.

T. leucanthum Bieb.: Flitton, 03T, 1979 (**LTN**), det. E. J. Clement. Wool alien.

Ulex minor Roth: remnant of heath, Heath and Reach, 93P, 1985 (**LTN**), *C. R. Boon*!. The first record of a species which is a feature of heaths a short distance away in north Hertfordshire.
Vicia tenuifolia Roth: railway bank, Westoning, 03G, 1971 (**LTN**). Well established.

Geraniaceae

Erodium gruinum (L.) L'Hér.: Flitton, 03T, 1970 (**LTN**), *E. J. Clement & T. B. Ryves*. Wool alien.
E. stephanianum Willd.: Maulden, 03N, 1971 (**LTN**). Wool alien.

Malvaceae

Anoda cristata (L.) Schlecht.: Maulden, 03N, 1976 (**LTN**), det E. J. Clement. Wool alien.
Lavatera punctata All.: Maulden, 03N, 1980 (**LTN**), *H. J. M. Bowen*! Wool alien.
L. trimestris L.: roadside, Luton, 01Z, 1982 (**LTN**). Garden origin and second record.
Malope trifida Cav.: The Lodge, Sandy, 14Y, 1976 (**LTN**). Bird seed alien.
Malva verticillata L.: Flitwick, 03G, 1971 (**LTN**). Wool alien.
Modiola caroliniana (L.) G. Don: Maulden, 03N, 1980 (**LTN**), det. E. J. Clement. Wool alien.
Sida spinosa L.: Maulden, 03N, 1976 (**LTN**). Wool alien.
Urocarpidium shepardae (Johnst.) Krapov.: Maulden, 03N, 1969 (**herb. E. J. Clement**), *E. J. Clement, J. L. Mason & T. B. Ryves*, det. C. C. Townsend. Wool alien.

Guttiferae

Hypericum maculatum Crantz subsp. *maculatum*: waste ground, Aspley Guise, 93N, 1972 (**LTN**), *H. B. Souster!*, det. N. K. B. Robson.

Umbelliferae

Bupleurum falcatum L.: garden, Ickwell, 14M, 1980, N. Dawson. Spontaneous and increasing.
Heracleum mantegazzianum Somm. & Levier: roadside, Ridgmont, 93T, 1979. See note in Dony (1953, p. 299).
Oenanthe crocata L.: canal bank, Linslade!, v.c. 24 [Beds.], 92C, 1981 (**LTN**), *H. B. Souster*. Not recorded from v.c. 30 since 1881.
O. lachenalii C. C. Gmel.: the record of *O. silaifolia* Bieb. in Dony (1969) was in error for this, the station being the only one now known for *O. lachenalii* in the vice-county.
Trachyspermum ammi (L.) Sprague: Bedford R.D.C. refuse tip, 05F, 1969 (**LTN**). Bird seed alien.

Convolvulaceae

Convolvulus erubescens Sims: Maulden, 03N, 1977 (**LTN**), det. E. J. Clement. Wool alien.

Boraginaceae

Anchusa azurea Mill.: waste ground, Luton, 12A, 1950 (**LTN**), det. E. J. Clement. Previous records of *A. officinalis* L. should probably be referred to this species.
Symphytum grandiflorum DC.: garden, Segenhoe Manor, 93Y, 1978 (**LTN**). Naturalized.

Labiatae

Salvia viridis L.: landfill site, Sundon, 02J, 1980 (**LTN**). Garden origin.

Solanaceae

Capsicum annuum L.: landfill site, Potton, 24E, 1983 (**LTN**); landfill site, Sundon, 02J, 1985. Bird seed alien.
Hyoscyamus albus L.: Bedford R.D.C. refuse tip, 05F, 1979 (**LTN**). Origin not known.
Physalis peruviana L.: landfill site, Sundon, 02J, 1983 (**LTN**), det. E. J. Clement. Bird seed alien.
Solanum laciniatum Aiton: landfill site, Sundon, 02J, 1985 (**LTN**), det. E. J. Clement. Origin not known.
S. nigrum L. × *S. sarrachoides* Sendtn. (*S.* × *procurrens* Leslie): Maulden, 03T, 1977 (**LTN**), *H. J. M. Bowen*! This hybrid was noted by Leslie (1978) from market-gardens at Potton and Sutton.

Scrophulariaceae

Melampyrum arvense L.: spoil heap, Lidlington!, 93U, 1975, A. J. Martin. This species has an interesting history in the county. The population of the most long-standing site, which had been maintained by periodic ditching that has now ceased, became reduced to two plants in 1983, since when none has been seen. In a second site at Bidwell there were 1000+ plants when it was first observed in 1946 but there followed a regular diminishing in the number of plants, the last ones being seen in 1970. At the Lidlington site an estimate of 5000+ plants was made by one observer, since when there has been a large annual reduction. Similar large populations in Essex, Wiltshire and the Isle of Wight, the only other counties in which it has appeared in recent years, have shown the same diminution, ending in all cases but one in the complete disappearance of the species. There can be little doubt that it is an alien introduction into Britain with impure grain seed, a view expressed long ago by Bromfield (1856) and many others since, including Salisbury (1961) and Webb (1985). It is, however, of considerable ecological interest as a hemiparasite.

Veronica hederifolia L. subsp. *hederifolia*: this subspecies appears to be common in the county, occurring most frequently on arable land.

V. hederifolia L. subsp. *lucorum* Klett & Richter: churchyard, Woburn, 93L, 1977 (**LTN**), conf. P. M. Benoit. This subspecies appears to be as common as the preceding and was observed in 24 additional tetrads, growing in shady places as well as in open areas.

Martyniaceae

Ibicella lutea (Lindl.) Van Eseltine: Flitton, 03T, 1976 (**LTN**). Wool alien.

Lentibulariaceae

Utricularia australis R.Br.: gravel pit, Felmersham, 95Z, 1951 (**LTN**), det. P. Taylor. Recorded in error as *U. vulgaris* L. in Dony (1953). It was first observed here, in a vegetative condition, in 1949 and is now well established, flowering annually in some quantity.

Rubiaceae

Asperula arvensis L.: The Lodge, Sandy, 14Y, 1982 (**LTN**), *I. K. Dawson*. Bird seed alien.

Galium pumilum Murr.: spontaneously in garden, Luton!, 02W, 1982 (**LTN**), *E. B. Rands*. The only previous record was from v.c. 20 [Beds.].

Caprifoliaceae

Lonicera caprifolium L.: hedgerow, Streatley, 02U, 1976 (**LTN**), *P. Ford*! Possibly bird-sown; only previous record 1889.

Campanulaceae

Downingia elegans (Douglas) Torrey: bank of mineral workings, Wavendon Heath, v.c. 24 [Beds.], 93H, 1981 (**LTN**), conf. E. J. Clement. Introduced with imported grass seed.

Compositae

Amellus microglossus DC.: Maulden, 03N, 1969 (**herb. E. J. Clement**), *E. J. Clement & T. B. Ryves*, det. C. C.Townsend. Wool alien.

A. strigosus Less.: Maulden, 03N, 1969 (**herb. E. J. Clement**), *J. L. Mason*. Wool alien.

Arctium tomentosum Mill.: landfill site, Sundon, 02J, 1970 (**LTN**). Origin not known.

Bidens connata Muhl.: Grand Union Canal, Linslade, v.c. 24 [Beds.], 92D, 1980 (**LTN**).

Chrysanthemum myconis L.: Flitton, 03T, 1968 (**LTN**), det. J. E. Lousley. Presumed to be a wool alien.

Cicerbita macrophylla (Willd.) Wallr.: roadside, Whipsnade, 01I, 1981. A remote site for a species known previously only as a garden escape.

Cichorium endivia L.: Flitwick, 03G, 1957 (**LTN**), det. E. J. Clement. Origin not known.

Cosmos bipinnatus Cav.: Maulden, 03N, 1982 (**LTN**). Wool alien.

Crepis setosa Haller f.: spontaneously in garden, Barton!, 03V, 1970 (**LTN**), *W. L. Stevens*. The only previous recent record was from v.c. 20 [Beds.]. The last record from v.c. 30 was in 1930.

Hieracium diaphanum Fr.: Rowney Warren, 14A, 1971 (**LTN**), det. P. D. Sell.

H. grandidens Dahlst.: railway bank, Souldrop, 96A, 1971 (**LTN**), det. P. D. Sell.
H. maculatum Sm.: railway bank, Harlington, 03F, 1971 (**LTN**).
H. vulgatum Fr.: Rowney Warren, 14A, 1971 (**LTN**), det. P. D. Sell.
Iva xanthifolia Nutt.: Maulden, 03N, 1976 (**LTN**), det. E. J. Clement. Wool alien.
Pilosella praealta (Vill.) C. H. & F. W. Schultz subsp. *arvorum* (Naegl. & Peter) P. D. Sell & C. West: railway bank, Moor End, 05E, 1971 (**LTN**), det. P. D. Sell. Origin not known.
Rudbeckia hirta L.: landfill site, Sundon, 02J, 1983 (**LTN**). Garden origin.

Hydrocharitaceae

Elodea nuttallii (Planch.) St. John: lake, Russell Park, Bedford, 04U, 1978 (**LTN**). This has since been recorded in other sites in the north of the county.

Potamogetonaceae

Potamogeton crispus L. × *P. friesii* Rupr. (*P.* × *lintonii* Fryer): water-storage tank, Roxton, 15M, 1973 (**BM**), det. J. E. Dandy. *P. crispus* is a common species in Bedfordshire but *P. friesii* rare: it would appear that *P. pusillus* L., which is common, could be a parent rather than *P. friesii*.
P. obtusifolius Mert. & Koch: Battlesden Lake, 92P, 1976 (**LTN**); Mermaids Pond!, 93H, 1981, *J. Morris*; flooded sandpit, Heath and Reach, 92J, 1982 (**LTN**).

Liliaceae

Allium oleraceum L.: Shelton, 06E, 1973 (**LTN**). The first confirmed record; still there in 1985.

Juncaceae

Juncus acutiflorus Ehrh. × *J. articulatus* L. (*J.* × *surrejanus* Druce ex Stace & Lambinon): marsh, Dropshort, 02D, 1972 (**LTN**), *P. M. Benoit*!
J. effusus L. × *J. inflexus* L. (*J.* × *diffusus* Hoppe): marsh, Dropshort, 02D, 1972 (**LTN**), *P. M. Benoit*!; marsh, Tebworth, 92Z, 1973 (**LTN**), *P. M. Benoit*!
J. tenuis Willd.: pond, The Lodge, Sandy, 14Y, 1976 (**LTN**); Kingshoe Wood, 93X, 1982 (**LTN**); Wavendon Heath, v.c. 24 [Beds.], 93H, 1984. This species is no longer at the station given in Dony (1953) and, while appearing to extend its range in the county, is not permanent.

Gramineae

Aegilops speltoides Tausch: Flitwick, 03G, 1977, ex hort. 1979 (**LTN**), det. C. E. Hubbard. Wool alien.
Agrostis castellana Boiss. & Reuter: bank of mineral workings, Wavendon Heath, v.c. 24 [Beds.], 93H, 1981 (**LTN**). Introduced with imported grass-seed.
A. exarata Trin.: bank of mineral workings, Wavendon Heath, v.c. 24 [Beds.], 93H, 1981 (**LTN**), det. E. J. Clement. Introduced with imported grass-seed.
A. scabra Willd.: Flitwick, 03G, 1977 (**LTN**), det. C. E. Hubbard. Wool alien.
Alopecurus antarcticus Vahl: Maulden, 03N, 1968 (**herb. E. J. Clement**), *E. J. Clement & T. B. Ryves*, det. C. E. Hubbard. Wool alien.
Anthoxanthum aristatum Boiss. (*A. puelii* Lecoq & Lamotte): bank of mineral workings, Wavendon Heath, v.c. 24 [Beds.], 93H, 1982 (**LTN**). Introduced with imported grass-seed. The last record from v.c. 30 was in 1919.
Apera interrupta (L.) Beauv.: dismantled railway, Henlow, 13M, 1973 (**LTN**). Casual.
Avena barbata Pott ex Link: Maulden, 03N, 1964 (**LTN**), det. C. E. Hubbard. Wool alien.
Bromus arvensis L.: field border, Dunton, 24G, 1970 (**LTN**), conf. C. E. Hubbard. Established for 15 years, but the site has now been ploughed.
B. lanceolatus Roth var. *lanuginosus* (Poir.) Dinsm.: Maulden, 03N, 1965 (**K**), det. C. E. Hubbard. Wool alien.
Cenchrus echinatus L.: Maulden, 03N, 1969 (**K**), det. C. E. Hubbard. Wool alien.
C. incertus Curtis: Maulden, 03N, 1967 (**K**), *J. L. Mason*, det. W. D. Clayton. Wool alien.
Danthonia racemosa R.Br.: Maulden, 03N, 1967 (**LTN**). Wool alien.
Deschampsia danthonioides (Trin.) Munro: Woburn Park, 93R, 1977 (**LTN**), det. C. E. Hubbard. Introduced with imported grass-seed and found subsequently at other sites.
Digitaria ctenantha (F. Muell.) Hughes: Maulden, 03N, 1967 (**K**), det. C. E. Hubbard. Wool alien.

Diplachne muelleri Benth.: Flitton, 03T, 1983 (**LTN**), det. E. J. Clement. It is possible that previous records of *D. fusca* (L.) Beauv. may be referred to this. Wool alien.

Echinochloa turneriana (Domin) Black: Maulden, 03N, 1967 (**herb. E. J. Clement**), *E. J. Clement & T. B. Ryves*, det. C. E. Hubbard. Wool alien.

Eleusine tristachya (Lam.) Lam.: Maulden, 03N, 1976 (**LTN**), det. C. E. Hubbard. Wool alien.

Eragrostis curvula (Schrad.) Nees: Maulden, 03N, 1967 (**LTN**), det. C. E. Hubbard. Wool alien.

E. molybdea Vicary: Maulden, 03N, 1976 (**LTN**), det. C. E. Hubbard. Wool alien.

E. procumbens Nees: Flitton, 03T, 1983 (**LTN**), det. E. J. Clement. Wool alien.

E. schweinfurthii Chiov.: Maulden, 03N, 1966 (**K**), det. C. E. Hubbard. Wool alien.

E. virescens J. & C. Presl: Flitton, 03T, 1982 (**LTN**). Wool alien.

Eremopyrum bonaepartis (Spreng.) Nevski: Flitwick, 03G, 1978 (**LTN**), det. E. J. Clement. Wool alien.

Eriochloa creba S. T. Blake: Maulden, 03N, 1967 (**LTN**), det. C. E. Hubbard. Wool alien.

Festuca heterophylla Lam.: shady drive, Podington, 96G, 1973 (**LTN**). Well established, but possibly introduced.

Hordelymus europaeus (L.) Harz. The only current record given in Dony (1953) was from v.c. 20 [Beds.]. It has now been found at four sites in v.c. 30, from which it was last recorded in 1906.

Panicum effusum R.Br.: Maulden, 03N, 1967 (**K**), *J. L. Mason*, det. C. E. Hubbard. Wool alien.

Parapholis incurva (L.) C. E. Hubbard: Maulden, 03N, 1969 (**K, herb. E. J. Clement**), *E. J. Clement & T. B. Ryves*, det. C. E. Hubbard. Presumed to be a wool alien here, but it is native elsewhere in Britain in dry saltmarshes.

Pennisetum clandestinum Hochst. ex Chiov.: Maulden, 03N, 1968 (**herb. T. B. Ryves**), *E. J. Clement & T. B. Ryves*. Wool alien.

Phalaris angusta Nees: Maulden, 03N, 1977 (**LTN**). Wool alien.

Poa schimperiana Hochst. ex A. Rich.: Maulden, 03N, 1966 (**K**), det. C. E. Hubbard. Wool alien.

P. sterilis Bieb.: Maulden, 03N, 1968 (**LTN**), det. C. E. Hubbard. Wool alien.

Puccinellia distans (L.) Parl.: waste ground, Thurleigh, 05P, 1973 (**LTN**). A coastal species that has been recorded from 66 tetrads in the county since 1973, on the margins of main roads. For an account of the increase of this species inland in recent years, see Scott and Davison (1982) and Scott (1985). There was one previous record from v.c. 30 in 1798.

Schismus arabicus Nees: Flitwick, 03G, 1978 (**LTN**), det. E. J. Clement. Wool alien.

Sorghum bicolor (L.) Moench: landfill site, Sundon, 02J, 1971 (**LTN**). Bird seed alien.

Sporobolus fimbriatus Nees: Maulden, 03N, 1976 (**K, LTN, herb. T. B. Ryves**), *E. J. Clement & T. B. Ryves*!, det. C. E. Hubbard. Wool alien.

Stipa brachychaetoides Speg.: Maulden, 03N, 1973 (**herb. T. B. Ryves**), *E. J. Clement & T. B. Ryves*, det. C. E. Hubbard. Wool alien.

S. falcata Hughes: Maulden, 03N, 1966 (**K, herb. T. B. Ryves**), *E. J. Clement & T. B. Ryves*, det. C. E. Hubbard. Wool alien.

S. formicarum Delile: Maulden, 03N, 1962 (**LTN**), det. C. E. Hubbard.

S. juergensii Hack.: Maulden, 03N, 1960 (**K**), *M. McCallum Webster*, det. C. E. Hubbard. Wool alien.

S. philippii Steud.: Maulden, 03N, 1969 (**herb. T. B. Ryves**), *E. J. Clement & T. B. Ryves*, det. C. E. Hubbard. Wool alien.

Lemnaceae

Lemna minuscula L.: moat, Hatch, 14N, 1985 (**LTN**), conf. A. C. Leslie.

Typhaceae

Typha angustifolia L. × *T. latifolia* L.: ditch, Lidlington!, 93Z, 1984 (**LTN**), *A. C. Leslie*. *T. latifolia* was the only parent present.

Cyperaceae

Carex hostiana DC.: Cow Common, 92W, 1952 (**K**), *E. Nelmes* (1955). This is the only confirmed record from v.c. 30. The site was ploughed shortly after Nelmes' visit.

C. hostiana DC. × *C. lepidocarpa* Tausch: as above. This is the only record from v.c. 30.

C. lepidocarpa Tausch: marsh, Toddington, 02E, 1979 (**LTN**); marsh, Dropshort, 02D, 1984; marsh, Eggington, 92S, 1985. This is no longer present at the sites given in Dony (1953, 1969).

C. pulicaris L.: Knocking Hoe!, 13F, 1978, *J. L. Mason*; old chalk quarry, Barton Hill!, 03A, 1982, *M. Massey*; Sundon Hill, 02P, 1978 (**LTN**). These are interesting additional records, as all three sites are on chalk downland, the species not having been recorded from the county in its normal habitat of "boggy places" since 1798. The only known record since then was made by C. Crouch (1898) on a chalk downland site near Sundon Hill where he found it growing "with *Pinguicula vulgaris* and *Parnassia palustris*". One of us (J.G.D.) remembers *Parnassia* growing there from 1917 until 1925. The three new records made independently over a short period may be the result of a minor climatic change, it being of some significance that *C. panicea* L. was observed in 1983 on another chalk downland (Habitat Study 12A), (Dony 1953). They also coincide with the records of *Epipactis palustris* (L.) Crantz from chalk downland (Dony 1969) and more recently *Dactylorhiza praetermissa* (Druce) Soó nearby (see below). These could be the result of one of the all too frequent orchid transplants, but transplants seem less likely to be the case with sedges over so wide an area.

Eleocharis palustris (L.) Roemer & Schultes subsp. *palustris*: side of pond, Woburn, 93K, 1981 (**LTN**), det. S. M. Walters. The only site now known in v.c. 30.

Scirpus maritimus L.: sandpit, Tiddenfoot, v.c. 24 [Beds.], 92B, 1973 (**LTN**); side of lake, Ampthill Park, 03J, 1974. For a previous record see Dony (1953). This species survives well in inland sites, but the means of introduction is not known.

Orchidaceae

Dactylorhiza incarnata (L.) Soó: marsh, Felmersham!, 95Y, 1978, *R. K. Saxton*. This is a welcome discovery of a healthy colony of a species feared to be lost in the vice-county through the filling-in of the Eaton Socon water-meadows and its non-appearance at its only other recently known site.

D. praetermissa (Druce) Soó. There have been four recent records for this species, which was feared lost in the vice-county. One, in 1980, was by R. M. Bateman who reported it on chalk downland (see below), near the site where *Epipactis palustris* (L.) Crantz was found in 1966 (Dony 1969). Non-flowering plants of *E. palustris* were seen in 1967 but none since.

D. praetermissa (Druce) Soó × *D. fuchsii* (Druce) Soó: chalk downland, Dunstable!, 1980, *R. M. Bateman*.

Gymnadenia conopsea (L.) R. Br.: pasture, Thurleigh!, 05T, 1982, *G. Dennis*. This is the first record from v.c. 30 since 1884, other than on chalk downland, where it is still common.

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The authors are indebted to an increasing number of local naturalists in v.c. 30 who have drawn their attention both to new sites and to plants of apparent interest. They are grateful for the assistance of many in plant identification, but most especially to E. J. Clement and the late C. E. Hubbard.

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Short Notes

SARRACENIA IN THE NEW FOREST

Members of the genus *Sarracenia* (pitcher plants) are native to the eastern seaboard of North America. One species, *S. purpurea*, is known to have been introduced to Europe: in particular it has naturalized from plantings in western Switzerland and central Ireland (Webb 1964). It has also been recorded during the past 20 years from three localities in northern England.

On 16th July 1984, the authors found a clump of a *Sarracenia* species in the New Forest, S. Hants., v.c. 11. This plant had erect, slender, trumpet-shaped pitchers which were yellow-green and broadened gradually from their bases to their orifices. It was not *S. purpurea*, which has decumbent, inflated pitchers that vary from green, suffused with red or purple, to almost completely red. Up the front of each pitcher was a distinct wing which was broadest at the base and became progressively narrower as the trumpet itself became wider. No flowers were present, but reference to Godfrey & Wooten (1979) led to the conclusion that the plant was *S. flava* L., a species of seepage zones, cypress swamps and bogs in the coastal plain area of south-eastern North America. With assistance from Miss C. Whitefoord, subsequent comparison with herbarium material held at **BM** confirmed the identification. North American populations of this species are variable: wings are usually narrow, but may be up to 3 cm wide towards the pitcher base and the pitchers themselves vary from yellow-green to almost entirely red, with a range of venation patterns (Schnell 1978). In the New Forest, the clump of pitchers (which appeared to originate from a single rootstock and was about 15 cm in diameter) was growing between tussocks of *Molinia caerulea* (L.) Moench on a seepage terrace at the side of a valley mire. Associated species were: *Myrica gale* L., *Calluna vulgaris* (L.) Hull, *Erica tetralix* L., *Juncus acutiflorus* Ehrh. ex Hoffm., *Carex echinata* Murr., *Eriophorum angustifolium* Honck., *Equisetum palustre* L. and *Sphagnum palustre* L. The area was well-frequented by ponies, as evidenced by the extent of trampling and grazing and by the quantity of dung in the vicinity.

At the time of the first visit, the clump consisted of three grazed leaves, six mature but ungrazed pitchers and six smaller leaves, either immature pitchers or phyllodia. Phyllodia are small, sword-shaped leaves, not growing to more than about one third the length of mature pitchers, which do not develop into pitchers. In *S. flava* they develop during the latter half of the growing season and persist through the winter, though in other species they may grow in the spring before pitchers are produced. On a second visit (24th August 1984), there were 19 grazed leaves, six mature pitchers and five small leaves (phyllodia or young pitchers). Mature pitchers were 34–36 cm tall, compared with maximum lengths of c. 90 cm found in material from North America.

There is a long history of cultivation of *S. flava* in Britain and different variants have been recognized (Masters 1881). The New Forest clump undoubtedly originated from introduced, cultivated stock, though it is not possible to determine how it arrived at this locality. The site is at least 200 m from the nearest road or track, although it is close to a walkway used by ponies. Apart from damage caused by these animals, there are no signs of recent disturbance; associated plants are well-grown and the vegetation cover is complete. Thus it would seem that direct planting in the recent past is unlikely. The plant appears to be selectively grazed and, on a third visit to the site in October 1984, no mature pitchers remained ungrazed. On 30th July 1985 the clump contained five mature pitchers, five developing pitchers or phyllodia, and 13 grazed leaves. Grazing pressure may be responsible for keeping the size of the clump in check and it is possible that it has existed in this area for a considerable time.

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CAREX MURICATA L. SUBSP. *MURICATA* NOT IN DEVON

Ivimey-Cook (1984) has reported that *Carex muricata* L. subsp. *muricata* "is thought to occur on the chalk in the vicinity of Branscombe and has also been recorded for Bideford". This is a sedge of northern and eastern Europe, largely replaced in the west by its close ally, the subspecies *lamprocarpa* Čelak. (= *C. pairaei* F. W. Schultz). Its presence in Britain was established by Nelmes (1947) who found herbarium specimens from four widely separated stations. To these only one more has since been added.

Although one of Nelmes' stations was in Gloucestershire (where the plant, though refound in 1973, now appears to be at least temporarily extinct), an occurrence in Devonshire is extremely improbable, for in Britain the habitat is closely restricted to very well drained limestone scree. Opportunities for error are, moreover, great: determination is not so very difficult – though the differences between the two subspecies are small they are quite definite (David 1979) – but the nomenclature has been very much confused.

L. J. Margetts has kindly and thoroughly investigated these Devonshire records. For 'Bideford' a specimen exists (now in **CGE**) and this turns out to be not a 'muricata' at all but *Carex otrubae* Podp. For 'Branscombe' no specimen has been preserved, but the finder was unaware that there are two subspecies of *C. muricata* proper and followed Jermy & Tutin (1968) in using the name merely to distinguish her plant from *C. muricata* subsp. *leersii* Aschers. & Graebn., now known (Chater 1980) as *C. divulsa* subsp. *leersii* (Kneucker) W. Koch. It is Margetts' opinion that the plant found was most probably *C. spicata* Huds., yet another member of the complex.

There is no reason, then, to suppose that *C. muricata* L. subsp. *muricata* is, or could be, in Devon. And I would beg all recorders not to publish records of this (in Britain) extremely rare plant before making the most thorough check of their authenticity.

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PETRORHAGIA NANTEULII (BURNAT) P. W. BALL & HEYWOOD IN MID-GLAMORGAN

In August 1985, *Petrorhagia nanteulii* (Burnat) P. W. Ball & Heywood (*Kohlrauschia prolifera* auct.) was discovered by the author in the Dare Valley Country Park, Aberdare, v.c. 41. It was found to be growing in a large established colony along with other grassland plants on a well drained embankment of a disused railway line.

P. nanteulii is a rare species found growing in sandy and gravelly places in south-eastern England and is also established as an alien. There are only two previous records for this species in Wales, both from Cardiff Docks (Ellis 1983). The most recent record was 1980, the previous record was 1926. Thus this site is the second in Wales so far discovered. Its presence on what was a busy railway line serving the coal mines and Gadlys Ironworks in the Dare Valley, ultimately connected with Cardiff Docks, gives a clue as to its possible origin. Coal mining operations ceased by the 1950s and the line fell into disuse. As the colony is well established it is conceivable that it has existed at this site for 30 years or more after being carried there, presumably on railway wagons loaded with imported iron ore.

ACKNOWLEDGMENTS

I am grateful to Dr J. R. Akeroyd of the Botany Department, Reading University and Mr R. G. Ellis of the National Museum of Wales for confirming the identification of this species.

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DACTYLORHIZA MACULATA (L.) SOÓ × *D. TRAUNSTEINERI* (SAUTER) SOÓ IN N.E. YORKS.

In mid-June 1985, I examined what may possibly be a previously unrecorded colony of *Dactylorhiza traunsteineri* (Sauter) Soó at a site east of Pickering, N.E. Yorks., v.c. 62, (GR 44/8.8). The location is a very small, isolated calcareous flush (approx. 10 m diameter), where *D. traunsteineri* and its putative hybrid with *D. maculata* (L.) Soó grow along with such normal associates as *Primula farinosa*, *Pinguicula vulgaris* and *Schoenus nigricans*. *Dactylorhiza maculata* grows close by and certainly within 30 m. The hybrid, *D. maculata* × *D. traunsteineri*, for which this is a new vice-county record and second English record, is rare in the British Isles.

The typical hybrid shows many features intermediate between the parents and is a relatively robust and distinctive plant generally 20–26 cm tall (at this site typical *D. traunsteineri* is 6–12 cm), with broader leaves than *D. traunsteineri*, marked with well-spaced dark blotches. The stem is stouter than in *D. traunsteineri* and the upper stem and bracts are not so deeply stained red-brown with anthocyanin. The flower colour is a very distinctive pale bluish-red, intermediate between the parents, and the lateral sepals are not held erect but arched forward into a semi-hood. The labellum is large and is lightly flecked with dots and broken loops, with the lateral lobes reflexed and the central lobe smaller than the laterals but of similar length, although perhaps closer in shape to *D. maculata*. The spur is shorter and more conical than in *D. traunsteineri*.

Although the characteristics as outlined above are found to be in close accord with those given by Roberts (1962), it is interesting that some of the plants had unspotted (rather than spotted) leaves and, in some cases, the usual pronounced reflexing of the lateral lobes of the labella was absent or reduced and, often, the flower spike was distinctly less lax than is usual.

A detailed description and colour photographs were sent to R. H. Roberts, who noted in these plants a greater leaf width and wider spur opening than in examples of the hybrid which he had observed, but agreed that the arched forward position of the lateral sepals, the shape and colour of the labellum, and the reduced anthocyanin staining of the upper stem and bracts indicate the hybrid. It is in fact quite possible that a hybrid swarm is present, with back-crossing and/or segregation causing some degree of variability, but such swarms, whilst demonstrated to occur for instance between *D. fuchsii* and *D. majalis* subsp. *purpurella* (Lord & Richards 1977), appear not to have been recorded for *D. maculata* × *D. traunsteineri*.

Herbarium specimens were not gathered, but colour photographs and detailed field notes are retained by the author.

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I wish to thank Mr R. H. Roberts for his help with these plants.

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SEED MORPHOLOGY IN *ARUM MACULATUM* L.

A recent study of seed morphology in *Arum maculatum* L. has shown some interesting differences between hedgerow and woodland populations of this species. Seven discrete populations of *A. maculatum* were sampled from the Deeside area (GR 33/29.69) of north-eastern Flints., v.c. 51. Four were from woodland and three from hedgerow habitats. In all, 77 fruiting spikes were collected during August 1981. In each case, the ripe berries were removed from the spike and a random subsample of twelve berries per population was selected. The enclosed seeds were separated from the pulp of each berry and the largest seed was chosen for further examination. Seed length and width were measured across the widest points respectively. The total sample was therefore represented by 84 seeds, i.e. twelve seeds per population. To determine overall and habitat mean seed weights, each sample of twelve seeds per population was weighed. This provided a total of seven population weights on which to calculate means.

The results are shown in Table 1. The overall means for seed length and width are similar to those obtained by Sowter (1949), i.e. c. 6 × c. 5 mm. Both seed length and width show continuous variation and are strongly correlated ($r=0{\cdot}74$, $p=0{\cdot}001$); this indicates that seed shape is fairly constant irrespective of absolute size.

TABLE 1. SEED MORPHOLOGY IN WOODLAND AND HEDGEROW POPULATIONS OF *ARUM MACULATUM* L.

Population characters	Woodland	Hedgerow	Total
No. of populations	4	3	7
No. of spikes	52	25	77
No. of seeds sampled	48	36	84
Mean seed length (mm) and S.D.	6·25±0·72 (n=48)	5·25±0·68 (n=36)	5·82±0·86 (n=84)
Mean seed width (mm) and S.D.	5·02±0·66 (n=48)	4·36±0·54 (n=36)	4·74±0·69 (n=84)
Mean L/W ratio and S.D.	1·3±0·1 (n=48)	1·2±0·1 (n=36)	1·2±0·2 (n=84)
Mean weight of 12 seeds (g) and S.D.	0·44±0·07 (n=4)	0·33±0·02 (n=3)	0·39±0·08 (n=7)

There are, however, statistically significant differences between the mean values of woodland and hedgerow populations (Table 1). The differences involve (a) mean seed length ($t=6{\cdot}5$, $p\leq0{\cdot}001$); (b) mean seed width ($t=5{\cdot}0$, $p\leq0{\cdot}001$); (c) mean seed weight ($t=10{\cdot}3$, $p\leq0{\cdot}001$); and (d) mean seed length/width ratio ($t=4{\cdot}5$, $p\leq0{\cdot}001$).

I therefore conclude that there is a relationship between seed size and habitat in *A. maculatum*. Salisbury (1942) was able to demonstrate a broad correlation between the average seed weight of a species and its preferred habitat. In particular, species from closed, woodland communities have larger seeds than those of more open habitats such as hedgerows. This example of intraspecific variation in seed size was not discussed by Prime (1960) nor by other students of *Arum*, e.g. Sowter (1949).

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OPHRYS APIFERA HUDSON SUBSP. *JURANA* RUPPERT FOUND IN BRITAIN

Every year since 1980, I have visited a site on the Wiltshire downs (v.c. 8) and, among a range of plants typical of chalk downland, I have recorded five species of orchid, *Listera ovata*, *Orchis mascula*, *Ophrys insectifera*, *O apifera* and *Dactylorhiza fuchsii*. *O. apifera* first appeared in June 1983, but the single specimen was not closely examined.

On 17th June 1984, a single spike of *O. apifera* was again found, in approximately the same position as the 1983 plant, and close examination of the flowers revealed that the two upper, inner perianth segments were of similar form and colour to the three outer perianth segments. Photographs were taken on 21st June and again on 23rd June, by which time four flowers had opened fully. These agreed in all details with the descriptions of *Ophrys apifera* Hudson subsp. *jurana* Ruppert given by Lang (1980) and Soó (1980) and also the descriptions and illustrations of this plant found in Duperrex (1961), Williams *et al*. (1978), Kohlhaupt (1981), Baumann & Künkele (1982) and Davies *et al*. (1983). Six flowers ultimately opened, and the spike reached a height of 28 cm. Photographs were sent to D.C. Lang, who agreed with the identification, and copies have been placed in **LTR**.

A visit to the site on 16th May 1985 revealed a developing rosette of leaves. Additional visits on 23rd June and 2nd July were made by D. C. Lang and myself, flowering being delayed to the latter date due to the late season.

The site is on an east-facing bank above a sunken track on the north side of a chalk hill. The flora is typical of chalk downland, and species recorded within 3 m of the plant include *Lotus corniculatus*, *Polygala vulgaris*, *P. calcarea*, *Helianthemum nummularium*, *Linum catharticum*, *Poterium sanguisorba*, *Thymus praecox*, *Asperula cynanchica*, *Cirsium acaule*, *Leontodon hispidus*, *Listera ovata* and *Dactylorhiza fuchsii*.

The plant had three basal leaves and two stem leaves, and reached a height of 26·5 cm with four mature flowers. Individual flowers varied slightly in size, the outer perianth segments averaged 13 mm long by 6 mm wide at the widest point, and the upper, inner perianth segments 10 mm long by 4 mm wide. The labellum was, on average, 8 mm wide. The upper, inner perianth segments were pink, with a green central rib, blunt and noticeably hairy on the margins. They tended to curl forward at the tips. The labellum pattern differed from that of the normal variant of *O. apifera*. The typical U-shaped pattern at the base was missing and, halfway down the labellum, an irregular horizontal yellow bar stretched across the entire breadth.

Seed-set was not observed in 1984. In 1985, self-pollination was evident in two of the flowers and, on 30th August, three well-developed seed capsules were present. All known sites for *O. apifera* within 6 km have been searched, but no specimens resembling subsp. *jurana* have been found.

The distribution of subsp. *jurana* is described generally as western-central and southern Europe (Williams *et al*. 1978; Soó 1980; Davies *et al*. 1983), but more specifically it has been found in parts of south-eastern France (Duperrex 1961) and south-western Germany (Baumann & Künkele 1982). Although no previous record of this subspecies in Britain appears to exist, it has recently been discovered in northern Germany and Holland by M. Ebbens (D. C. Lang pers. comm.). Careful examination of *O. apifera* flowers might reveal that this subspecies is more widely spread than appears at present.

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I am indebted to D. C. Lang for help in identification, and for encouragement and suggestions in writing this note.

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THE STATUS OF *ORCHIS FRANCIS-DRUCEI* WILMOTT

Wilmott (1936) described a new species of orchid, *Orchis francis-drucei*, following its discovery whilst he was on an excursion with Francis Druce in north-western Scotland. This new species was described as being slender in habit, with few narrow leaves, and a short, lax-flowered inflorescence, with a long, projecting, median lobe of the labellum. Wilmott recognized that these characters were shared by a species then known as *O. traunsteineri* Sauter, which at that time had not been recognized from the British Isles; he distinguished the Scottish plants as being smaller and having a very long median labellum lobe, which also had intense reddish-purple markings on a white background.

O. francis-drucei was originally described from a single colony found on a hill slope above Loch Maree, W. Ross, v.c. 105. Since its discovery on 23rd June 1935, the plant has apparently remained undetected until a colony of similar plants was found by M.R.L. in June 1983 near Loch Maree. A study of this colony of some 40 plants was undertaken by the authors the following year, and specimens sent to Mr R. H. Roberts were confirmed beyond any doubt as *Dactylorhiza traunsteineri* (Sauter) Soó.

The detailed description, illustrations and plates published by Wilmott (1936) enable a comparison of the 1935 and 1984 populations with each other and with a generalized description of *D. traunsteineri* (Table 1). In spite of the differences, the 1984 plants are clearly conspecific both with the 1935 plants described as *O. francis-drucei* and with *D. traunsteineri*. It is assumed that the variation between the two collections is either because the 1984 population was a different one or that the 1935 population is the same but consisted of variants which are no longer dominant in this population.

It has been demonstrated by Roberts & Gilbert (1963) that small isolated populations of *D.*

TABLE 1. COMPARISON OF *O. FRANCIS-DRUCEI* WITH *D. TRAUNSTEINERI*
Figures in brackets show mean values

Character	*O. francis-drucei*[a]	*D. traunsteineri*[b] West Ross	*D. traunsteineri*[c] Generalized
Height (cm)	11–13	10–18 (14·2)	10–32
Total no. leaves	4	3–5 (3·7)	3–5
No. non-sheathing leaves	0	0–1 (0·8)	0–1 (0·7)
Length of longest leaf (cm)	4	4–10 (7·6)	6–12
Max. width of longest leaf (cm)	0·4–0·5	0·8–1·3 (1·1)	0·6–1·5
Leaf spotting	unspotted	mainly lightly spotted with small dots or bars	markings light or absent
Leaf colour	pale green	pale green	pale green
Bracts	deeply suffused purple	deeply suffused purple	usually deeply suffused purple
Floral spike	sub-secund with 5–8 flowers	secund with 4–11 flowers	frequently secund with 2–20 flowers
Labellum length × width (mm)	7 × 6	(7·2) × (8·5)	6·5–8·5 × 0·7–1
Labellum shape and colour	sub-deltoid obtriangular with a long projecting mid-lobe, intense reddish purple markings on a white ground	more or less deltoid with a prominent mid-lobe, intense markings on a background of magenta to pale pink	more or less deltoid with less distinct mid-lobe than column (b), colour as column (b)
Spur length × width (mm)	6 × 2·3	(7·7) × (2·4)	8–9 × 3·0–3·5
Length of peripheral bract cells (μm)	—	(c. 110)	(c. 110)

[a] Wilmott (1936).
[b] Field measurements on 20 plants by the authors in 1984 near Loch Maree.
[c] Heslop-Harrison (1953), Roberts & Gilbert (1963) & R. H. Roberts (pers. comm.)

traunsteineri may be uniform but possess features at variance with other populations in the British Isles. Such local variation, when considered with Heslop-Harrison's (1953) concept of 'anthocyanin high' and 'anthocyanin low' modes for flower colour and leaf markings, offers an explanation for the differences between Wilmott's *O. francis-drucei* and *D. traunsteineri* in the British Isles. The only character which distinguishes both the 1935 and 1984 W. Ross plants from typical *D. traunsteineri* is the somewhat narrower spur (Table 1), which is not thought to be of high significance. We therefore consider that *O. francis-drucei* Wilmott should be regarded as wholly synonymous with *D. traunsteineri* and not be given even infra-specific status.

In 1983, *D. traunsteineri* was removed as a species known with certainty to occur in Scotland (Tennant & Kenneth 1983). The 1984 Loch Maree record therefore re-establishes *D. traunsteineri* as a Scottish plant beyond doubt. Moreover, a population has recently been recognized from Westerness, v.c. 97, (Mr D. C. Lang and Miss L. M. Watson, pers. comm.) that should be referred to *D. traunsteineri*, and a solitary plant found by the authors in 1984 in Knapdale, Kintyre, v.c. 101, is also this species; there is little doubt that further fieldwork will reveal it elsewhere in Scotland. Specimens and photographs of the 1984 Loch Maree dactylorchids have been placed in E.

The 1984 population occurred in a series of open flushes dominated by *Molinia caerulea* and *Schoenus nigricans* with penetration of *Erica tetralix*, *Salix aurita* and *Myrica gale* from the surrounding heath community. A full list of the species recorded showed the vegetation to be referable to the *Pinguiculo-Caricetum* Jones described by Wheeler (1980). (This unit includes the *Cariceto-Saxifragetum* and *Carex panicea-Campylium stellatum* syntaxa of McVean & Ratcliffe (1962), both widespread in base-rich flushes in Scotland). The vegetation is also similar to the W. Ross site for *D. incarnata* subsp. *cruenta* (Kenneth & Tennant 1984). *D. incarnata* subsp. *incarnata* and subsp. *pulchella* were both present at the 1984 Loch Maree site, and *D. maculata* subsp. *ericetorum* occurred in more acid parts nearby. Several rather robust dactylorchids were also noted near the periphery of this site and were initially suspected to be the hybrid *D. incarnata* × *D. traunsteineri*, although this could not be confirmed; no other dactylorchids were found in the immediate vicinity.

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CROSS-POLLINATION BY WASPS IN *EPIPACTIS LEPTOCHILA* (GODF.) GODF. S.L.

This note describes what I believe to be the first published observation of cross-pollination in those species of *Epipactis* which are generally regarded as being autogamous, i.e. automatically self-pollinated. In the flora of the British Isles, these comprise *E. leptochila* (Godf.) Godf., its very close relative *E. dunensis* (T. & T. A. Stephens.) Godf., *E. phyllanthes* Sm. and *E. youngiana* Richards & Porter.

In the other species of *Epipactis* in the British Isles, it is believed that within-flower pollination rarely occurs and that pollen transfer is usually between flowers (allogamy), either on the same (geitonogamy) or different (xenogamy) genets. It was Darwin (1862) who first showed that the allogamous species (*E. helleborine* (L.) Crantz, *E. purpurata* Sm., *E. atrorubens* (Hoffm.) Schult.) are usually pollinated by wasps (*Vespa* spp.); *E. palustris* (L.) Crantz is also allogamous but is usually visited by bees. These species are, however, self-compatible, so geitonogamous selfing is possible. Wasps visit the flowers to drink nectar, which is located in the proximal, hemispherical and usually purplish segment of the labellum (hypochile). To reach the hypochile, the head or top of the thorax of the wasp rubs against the projection on the outer end of the stigma (rostellum), which is covered by a sticky, whitish membrane (viscidium). The two pollinia drop from the anther into grooves (clinandria) shortly after the flower opens, in which position they adhere apically to the viscidium. When a wasp leaves a flower, the viscidium together with one or both pollinia adhere to the wasp. When a subsequent flower is visited, part or all of one or both pollinia may be deposited in the wet secretion of the stigma surface (just inside the position of the rostellum), thereby achieving allogamous pollination. However, Hagerup (1952) noted that when pollinia are not removed, some self-pollination occurs within the flower (autogamy) as the viscidium ages and flows onto the stigma surface, carrying the pollinia with it.

In contrast, in the autogamous species, the rostellum is small (except in *E. youngiana*) and the viscidium is missing, or is present in bud but disappears before or shortly after the flower opens. The flower is usually greenish, inclined, and less fully open than in the allogamous species. The pollinia rest uneasily in the shallow clinandria, and rapidly break up and fall onto the stigma unimpeded because the viscidium is absent. It is usually considered that such plants are invariably self-pollinated, and this must certainly be so for cleistogamous variants, in which the flower never opens, and is probably so for the variants of *E. phyllanthes* in which self-pollination occurs before the flower opens. However, Proctor & Yeo (1973) and Richards (1982) have speculated that some casual allogamy in the supposedly autogamous *E. leptochila*, *E. dunensis* and *E. youngiana* might be caused by insect visitors, to which parts of disintegrating pollinia might adhere. The biological importance of the allogamous and autogamous breeding systems has been illustrated by Richards (1982), who showed that four populations of three allogamous species are more variable than five populations of four autogamous species for each of ten metric characters.

On 10th August 1985 at 16.00 hrs, I visited a population of the inland Northumberland variant of *E. leptochila* (Richards & Swan 1976), many individuals of which closely resemble *E. dunensis*. This population grows on lead-mine spoil under birch trees beside a road leading into a caravan site. Some 30 individuals were flowering, with 5–35 flowers per spike, approximately half of which were open and not withered. Within an area of 1 m^2 were seven spikes next to the road in filtered sunlight, where the shade temperature was approximately 20°C. For at least 30 minutes, these received the intermittent but urgent attention of at least five workers of the wasp *Vespa germanica* Fab. The wasps were drinking nectar from the hypochile for periods of 5–60 seconds per flower. For twelve recorded spike visits, from three to five flowers were visited; these were usually adjacent to each other and in the middle of the region of the open flowers on a spike. Some feeding took place at every flower which the wasp visited, and the wasps alighted on every flower that was approached; however, wasps usually visited adjacent flowers by crawling.

Although viscidia were present within large buds (determined by dissection), almost all open flowers lacked a viscidium, and the rostellum was poorly marked, the outer edge of the stigma being rather straight with only a slight rostellar peak. For three spikes, only the topmost open flower had a detectable viscidium. Pollinia remained in the anther or on the clinandria in 15 out of a sample of 61 open flowers in which the stigma was greenish (and therefore presumed to be receptive) rather than brownish. On six occasions, a wasp was observed to visit a flower with pollinia in situ. On each occasion, all or most of both pollinia adhered to the head or to the front of the top of the thorax of the wasp when it left the flower, despite the apparent absence of a visible viscidium of the type found in allogamous species. When a wasp visit was simulated using the sharpened end of a pencil, the pollinia adhered to the bare wood surface of the pencil. All the five wasps that were closely observed were carrying pollinia on, or just behind, the head; a minimum of three and a maximum of at least eight pollinia were observed on different wasps at various times. In some cases, pollinia had adhered on the top of other pollinia, making an accurate estimation difficult.

Wasps carrying pollinia were observed visiting about 30 flowers with apparently receptive stigmas. In no cases were whole pollinia or parts of pollinia large enough to be detected by the naked eye on stigmas, although in every case that was closely observed, the pollinia on the wasp were clearly brought into contact with the stigma as the wasp drank. It seems very likely however that some pollen was deposited on stigmas, either as individual tetrads or as very small fragments. In between flower visits, wasps tried vigorously to remove pollinia from their heads using their front legs, but in this they were apparently unsuccessful. However, it is likely that such efforts would loosen tetrads and massulae from the pollinium, making them available for pollination.

From the same sample of 61 flowers with apparently receptive stigmas, whole pollinia or parts of pollinia large enough to be observed with the naked eye were seen in 19 flowers. It is assumed that these resulted from within-flower pollination, because between-flower visits by wasps apparently did not leave large pollinium fragments on stigmas. It follows that for 42 of 61 flowers in this 'autogamous' population, within-flower pollination had not occurred; in most the pollinia were missing.

Within the 1 m^2 that was intensively studied, the minimum distances between spikes were 5, 10, 15, 20 and 50 cm respectively. Nine out of 30 between-flower transfers by wasps were between spikes and should therefore have resulted in at least some cross-pollination. As pollinia apparently adhere to wasps for some time, releasing pollen slowly, pollen carry-over should be large, and the potential for cross-pollination should be considerable.

It is concluded that in apparently autogamous populations of *Epipactis* in which the viscidium is absent in open flowers and large parts of pollinia fall onto the stigma of the same flower at an early stage, substantial amounts of cross-pollination may occur. The high level of pollinator activity (observed fortuitously and briefly on this occasion) might be ascribed to a pleasantly warm, sunny, still interlude in a dismal summer. Out of many observations of populations of *E. leptochila* s.l. in different years, I have seen wasps visiting the flowers only on rare occasions, and then casual visiting by single individuals seemed to be occurring.

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Plant Records

Records for publication must be submitted to the appropriate vice-county Recorder (see *Vice-county Recorders* (1985)), and *not* the Editors. The records must normally be of species, hybrids or subspecies of native or naturalized alien plants belonging to one or more of the following categories: 1st or 2nd v.c. record, 1st post-1930 v.c. record; only extant v.c. record, or 2nd such record; a record of an extension of range by more than 100 km. Such records will also be accepted for the major islands in v.cc. 102–104 and 110. Only 1st records can be accepted for *Rubus*, *Hieracium* and hybrids. Records for subdivisions of vice-counties will not be treated separately; they must therefore be records for the vice-county as a whole. Records of *Taraxacum* are now being dealt with separately, by Dr A. J. Richards, and will be published at a later date.

Records are arranged in the order given in the *List of British vascular plants* by J. E. Dandy (1958) and his subsequent revision (*Watsonia*, **7**: 157–178 (1969)). All records are field records unless otherwise stated. With the exception of collectors' initials, herbarium abbreviations are those used in *British and Irish herbaria* by D. H. Kent & D. E. Allen (1984).

The following signs are used:

* before the record: to indicate a new vice-county record.
† before the species number: to indicate that the plant is not a native species of the British Isles.
† before the record: to indicate a species which, though native in some parts of the British Isles, is not so in the locality recorded.
[] enclosing a previously published record: to indicate that the record should be deleted.

1/4. LYCOPODIUM CLAVATUM L. **59**, S. Lancs.: Little Lever, Bolton, GR 34/74.07. Waste ground near moors. V. Gordon, 1985. 1st post-1930 record.

4/1. EQUISETUM HYEMALE L. **93**, N. Aberdeen: Tarty, GR 38/97.26. Flushed scrub. D. Welch, 1984. 2nd extant record.

4/9 × 5. EQUISETUM ARVENSE L. × E. FLUVIATILE L. ***78**, Peebless.: W. of N. Esk Reservoir, West Linton, GR 36/15.58. H. McHaffie, 1983, det. C. N. Page.

4/10. EQUISETUM TELMATEIA Ehrh. **109**, Caithness: Below Niandt, GR 39/20.33. Coastal cliff. J. Mackintosh, 1983. 2nd record.

7/1. HYMENOPHYLLUM TUNBRIGENSE (L.) Sm. **47**, Monts.: Near Aberllefenni, GR 23/7.1. Shaded rock by stream. P. M. Benoit *et al.*, 1985. 2nd record.

7/2. HYMENOPHYLLUM WILSONII Hook. **76**, Renfrews.: Derol Glen, Port Glasgow, GR 26/31.74. Boulders in stream. A. McG. Stirling, 1981. 2nd record.

15/5 tri. ASPLENIUM TRICHOMANES L. subsp. TRICHOMANES ***73**, Kirkcudbrights.: Near Borgan, GR 25/36.74. Granite boulder. O. M. Stewart, 1985, **E**.

16/1. CETERACH OFFICINARUM DC. **25**, E. Suffolk: Mendham, GR 62/26.82. Church wall. F. W. Simpson, 1984. 2nd extant record.

21/8. DRYOPTERIS AEMULA (Ait.) Kuntze **47**, Monts.: Afon Crewi, GR 22/8.9. Wooded gorge. A. J. Morton, 1984, conf. P. M. Benoit. 2nd record.

25/int. × 1. POLYPODIUM INTERJECTUM Shivas × P. VULGARE L. ***41**, Glam.: Kenfig Burrows, GR 21/7.8. Sand dunes. G. Hutchinson, 1985, det. R. H. Roberts.

†27/1. AZOLLA FILICULOIDES Lam. ***52**, Anglesey: Near Llyn Alaw, GR 23/40.86. Pond. T. Blackstock, 1984.

28/1. BOTRYCHIUM LUNARIA (L.) Sw. ***76**, Renfrews.: Near Old Hall, Kilmacolm, GR 26/36.71. Old pastures. K. M. Calver, 1976.

29/1a. Ophioglossum vulgatum L. subsp. vulgatum **76**, Renfrews.: Skiff Wood, GR 26/40.60. Woodland edge. A. J. Silverside, 1978. Only extant record.

†43/3. Anemone apennina L. ***49**, Caerns.: Treborth, GR 23/5.7. E. T. Jones, 1936.

46/7. Ranunculus sardous Crantz ***32**, Northants.: Finedon, GR 42/91.70. Infilled ironstone workings. I. Cameron, 1981. Duston Mill Lane, Northampton, GR 42/72.60. Disturbed ground. A. Robinson, 1982. 1st and 2nd records.

46/10. Ranunculus auricomus L. **46**, Cards.: Near Coedmore Mansion, GR 22/19.43. Ash-beech wood. A. O. Chater, 1985, **NMW**. 2nd record.

46/cal. Ranunculus calcareus Butcher ***25**, E. Suffolk: Tattingstone, GR 62/12.35. Stream. E. M. Hyde, 1984, **herb. E. M. & M. Hyde**, det. N. T. H. Holmes.

57/2. Ceratophyllum submersum L. ***38**, Warks.: Near Warwick, GR 42/27.68. Pond. J. C. Bowra, 1985, det. R. J. Pankhurst.

†64/for. Dicentra formosa Walpers ***44**, Carms.: Near Cwmann, GR 22/62.46. Hedgebank. A. O. Chater, 1985. **99**, Dunbarton: Clachan Woods, Rosneath, GR 26/22.82. Woodland bank. A. McG. Stirling & A. Rutherford, 1982. 2nd record.

66/2. Fumaria capreolata L. ***93**, N. Aberdeen: Eden, GR 38/69.59. Farmyard. D. Welch, 1985, **ABD**.

66/8 wir. Fumaria officinalis L. subsp. wirtgenii (Koch) Arcangeli ***46**, Cards.: Between Byrlip and Coybal, GR 22/36.58. Disturbed soil. J. R. Akeroyd & C.D. Preston, 1985, **CGE**, det. P. D. Sell.

†72/1. Diplotaxis muralis (L.) DC. †**76**, Renfrews.: Paisley College, GR 26/48.63. A. J. Silverside, 1977, **PSY**.

79/6. Lepidium latifolium L. †***32**, Northants.: Collyweston Great Wood, GR 53/00.01. Disturbed soil by A47. G. M. Gent, 1985.

[†79/7. Lepidium graminifolium L. **59**, S. Lancs.: Delete record in *Watsonia* **15**: 392; plant is *L. sativum* L., conf. E. J. Clement]

†80/2. Coronopus didymus (L.) Sm. ***99**, Dunbarton: Near Craigendoran Pier, GR 26/31.81. Waste ground. A. Rutherford, 1985, **E**.

†81/1. Cardaria draba (L.) Desv. **76**, Renfrews.: R. Cart, Renfrew, GR 26/49.68. River bank. A. McG. Stirling, 1981. 2nd record. ***98**, Main Argyll: Newtown Bay, Inveraray, GR 27/05.05. Shingle. B. H. Thompson, 1984, **herb. B.H.T.**

†Aethionema grandiflorum Boiss. ***29**, Cambs.: Sidney Sussex College, Cambridge, GR 52/43.58. Wall. P. D. Sell, 1966, **CGE**. Still present in 1977.

†90/2. Bunias orientalis L. ***12**, N. Hants.: Woolmer Forest, GR 41/8.3. Dr Drake, 1917, **RDG**.

102/5. Rorippa amphibia (L.) Bess. ***76**, Renfrews.: Newlands, Glasgow, GR 26/57.60. Roadside hedge. P. Macpherson, 1970, **herb. P. M.**, det. R. D. Meikle.

†105/1. Erysimum cheiranthoides L. ***76**, Renfrews.: Paisley, GR 26/47.65. Disturbed ground. A. J. Silverside, 1977.

112/2. Reseda lutea L. ***98**, Main Argyll: Glencruitten Road, Oban, GR 17/8.2. Rubble. V. Hyslop, 1984, det. M. McC. Webster.

113/6. Viola canina L. **79**, Selkirks.: Ettrickbridge End, GR 36/39.24. Rocks by river. 1984. **80**, Roxburghs.: Scaw Knowe, Ancrum, GR 36/62.25. Grassland. 1985. Both R. W. M. Corner, **herb. R.W.M. Corner**. 2nd records.

113/6 × 4. Viola canina L. × V. riviniana Reichb. ***70**, Cumberland: Greengill, GR 35/53.36. Sandy soil. R. W. M. Corner, 1985, **LANC**.

121/1. FRANKENIA LAEVIS L. **11**, S. Hants.: Tournerbury, Hayling Island, GR 40/7.9. Saltmarsh. Lady A. Brewis, 1984. 2nd extant record.

122/1. ELATINE HEXANDRA (Lapierre) DC. ***76**, Renfrews.: Loch Libo, GR 26/43.55. Sandy loch bay. A. J. Silverside, 1979.

124/2. LYCHNIS VISCARIA L. **85**, Fife: G. H. Ballantyne & M. Benstead, 1985. Locality confidential. 1st record since 1903.

130/nan. PETRORHAGIA NANTEUILLII (Burnat) P. W. Ball & Heywood †**41**, Glam.: Dare Valley Country Park, GR 22/99.02. Grassy bank. H. J. Dawson, 1985, **NMW**. 2nd record.

131/10. CERASTIUM DIFFUSUM Pers. **43**, Rads.: Bach Howey viaduct, GR 32/10.42. Roadside. R. G. Woods, 1985. 2nd record.

132/1. MYOSOTON AQUATICUM (L.) Moench †***70**, Cumberland: Salta, GR 35/08.45. Rubbish dump. M. Milne, 1985, **LANC**.

133/3. STELLARIA PALLIDA (Dumort.) Piré **51**, Flints.: Graig, Tremeirchion, GR 33/0.7. Limestone grassland. J. A. Green, 1985. 2nd record. **73**, Kirkcudbrights.: Cardoness, GR 25/56.52. Sandy ground near shore. O. M. Stewart, 1985. 2nd record.

136/2. SAGINA APETALA Ard. subsp. APETALA †***77**, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Bare ground. P. Macpherson & E. Teasdale, 1984, **herb. P. M.**, conf. F. N. Hepper.

137/4. MINUARTIA HYBRIDA (Vill.) Schischk. †**61**, S. E. Yorks.: Kipling Cotes, GR 44/92.43. Railway track. Dr Grant, 1985. 2nd record.

143/1. SPERGULARIA RUBRA (L.) J. & C. Presl ***98**, Main Argyll: Balinoe, Loch Feochan, GR 17/85.20. Glen Lonan, GR 17/95.25. Both on edge of forest road. B. H. Thompson, 1984. 1st and 2nd records.

149/1b. MONTIA FONTANA L. subsp. CHONDROSPERMA (Fenzl) Walters **47**, Monts.: Pen-y-graig, Darowen, GR 23/84.01. Seasonally damp soil over rock. P. M. Benoit *et al.*, 1985. 2nd record.

†149/2. MONTIA PERFOLIATA (Donn ex Willd.) Howell ***52**, Anglesey: Beaumaris, GR 23/6.7. A. J. Armitstead, 1926. **76**, Renfrews.: Paisley College, GR 26/48.63. Garden weed. A. J. Silverside, 1977. 1st post-1930 record.

†154/17. CHENOPODIUM CAPITATUM (L.) Aschers. ***26**, W. Suffolk: Lakenheath R.A.F. base, GR 52/7.8. Sandy ground. A. Brown, 1983, det. C. J. King.

156/1. ATRIPLEX LITTORALIS L. **75**, Ayrs.: Monkton, Ayr, GR 26/34.27. Muddy tidal flats. J. Swarbrick, 1964, **herb. G. W. Swarbrick**. 2nd record.

156/3. ATRIPLEX PROSTATA Boucher ex DC. ***77**, Lanarks.: R. Clyde, Shieldhall, GR 26/54.66. P. Macpherson, 1985, **herb P.M.**

156/lon. × 3. ATRIPLEX LONGIPES Drejer × A. PROSTRATA Boucher ex DC. ***25**, E. Suffolk: Landguard Common, GR 62/28.32. Sandy ground. A. Copping, 1984, **herb. E.M. & M. Hyde**, det. P. M. Taschereau.

†163/3. MALVA NICAEENSIS All. ***70**, Cumberland: Silloth, GR 35/11.53. N. Botham & M. Milne, 1985, **LANC**, det. G. Halliday.

†ABUTILON THEOPHRASTI Medicus ***77**, Lanarks.: King George V dock, Glasgow, GR 26/52.66. Waste ground. P. Macpherson & E. Teasdale, 1984, **herb. P. M.**

167/1. RADIOLA LINOIDES Roth ***98**, Main Argyll: Degnish, Loch Melfort, GR 17/75.10. Sandy soil by track. B. H. Thompson, 1984, **herb. B.H.T.**

168/7. GERANIUM SANGUINEUM L. ***76**, Renfrews.: S. of Gourock, GR 26/2.7. Grassy bank above shore. A. McG. Stirling, 1979.

168/9. Geranium pyrenaicum Burm. f. †*77, Lanarks.: Carmunnock, GR 26/60.57. Waste ground. P. & B. C. M. Macpherson, 1985, **herb. P.M.** †*93, N. Aberdeen: Leslie, GR 38/59.24. Waste ground. D. Welch, 1984, **ABD**.

168/10. Geranium columbinum L. **80**, Roxburghs.: Smailholm Crags, GR 36/63.34. S.-facing ledge. R. W. M. Corner, 1985, **herb. R.W.M.C.** 1st record since 1853.

†168/ibi. × pla. Geranium ibiricum Cav. × G. platypetalum Fischer & C. A. Meyer ***76**, Renfrews.: Lochwinnoch, GR 26/35.61. Quarry. A. J. Silverside, 1976, **PSY**. S. of Newton Mearns, GR 26/52.54. Waste ground. P. Macpherson, 1978, **herb. P.M.**, det. E. J. Clement. 1st and 2nd records.

169/3. Erodium cicutarium L'Hér. †**76**, Renfrews.: Near Erskine Hospital, GR 26/45.72. A. McG. Stirling, 1983. Only extant record.

†170/4. Oxalis europaea Jord. **43**, Rads.: Argoed Mill, Doldowlod, GR 22/99.62. Refuse tip. R. G. Woods, 1985. 2nd record.

171/1. Impatiens noli-tangere L. †**67**, S. Northumb.: Bolam, GR 45/08.81. Wet wood. C. Crawford, 1985, **herb. G.A. Swan**. 2nd record.

†183/2. Lupinus arboreus Sims ***73**, Kirkcudbrights.: Near Meikle Culloch, GR 25/84.63. Roadside bank. O. M. Stewart, 1985.

185/2. Genista anglica L. **51**, Flints.: Llyn Helyg, GR 33/1.7. Marsh. J. A. Green, 1985. 2nd extant record.

190/1. Medicago falcata L. †**38**, Warks.: Stonydelph, GR 43/24.01. Waste ground. M. A. Arnold & H. Morrall, 1985. 2nd record.

†191/2. Melilotus officinalis (L.) Pall. ***78**, Renfrews.: Lonend, Paisley, GR 26/48.63. Disturbed ground. A. McG. Stirling, 1980.

†191/4. Melilotus indica (L.) All. ***77**, Lanarks.: Kelvinhaugh, GR 26/55.66. Waste ground. P. Macpherson & A. McG. Stirling, 1985, **herb. P.M.** 1st record of established population.

192/1. Trifolium ornithopodioides L. **85**, Fife: Balmerino, GR 37/35.24. Rocky spur by shore. M. Benstead, 1985. 1st post-1930 record.

192/10. Trifolium striatum L. †***76**, Renfrews.: Paisley, GR 26/48.64. Lawn weed. A. J. Silverside, 1980.

195/2. Lotus tenuis Waldst. & Kit. ex Willd. **67**, S. Northumb.: Near Newlands, GR 45/09.55. Roadside bank. G. A. Swan, 1985, **herb. G.A.S.** 1st post-1930 record.

200/1. Astragalus danicus Retz. ***93**, N. Aberdeen: Sands of Forvie, GR 48/00.25. Rabbit-grazed bank. B. Davis, 1981, conf. D. Welch.

202/1. Ornithopus perpusillus L. **99**, Dunbarton: Duntocher, Glasgow, GR 26/48.72. Sandy trackside. A. McG. Stirling & A. Rutherford, 1985, **E**. 2nd record, 1st since 1891.

†203/1. Coronilla varia L. ***67**, S. Northumb.: Near Wylam, GR 45/12.64. Hedge by disused railway. G. A. Swan, 1985, **herb. G.A.S.**

206/2. Vicia tetrasperma (L.) Schreb. **73**, Kirkcudbrights.: Balmae Ha'en, GR 25/67.44. Rocky ground by shore. O. M. Stewart, 1985, **E**. 1st record since 1843 record from Balmae. †**80**, Roxburghs.: Hardies Hill, Hawick, GR 36/50.13. Railway ballast. A. J. Smith, 1985, **herb. R.W.M. Corner**. 1st record since 1917.

†206/6. Vicia villosa Roth **70**, Cumberland: Silloth, GR 35/11.53. M. Milne, 1985, **LANC**, det. G. Halliday. 2nd record, 1st this century.

†206/6 vill. Vicia villosa Roth subsp. villosa ***77**, Lanarks.: Kelvinhaugh, GR 26/55.66. Waste ground. A. McG. Stirling, 1985, **GL**.

206/16. Vicia lathyroides L. †**76**, Renfrews.: Paisley College, GR 26/47.63. Garden weed. A. J. Silverside, 1980. 2nd record.

206/seg. Vicia segetalis Thuill. *4, N. Devon: Braunton Burrows, GR 21/45.33. Sand dunes. L. J. Margetts, 1985.

207/2. Lathyrus nissolia L. 57, Derbys.: Lower Hartshay, GR 43/39.51. Grassy roadside bank. Mr Wilson, 1985, det. R. Smith. 1st post-1930 record.

†209/2 × 1. Spiraea douglasii Hook. × S. salicifolia L. *69, Westmorland: N. end of Grasmere, GR 35/33.06. Lakeside. G. Halliday, 1984, **LANC**, det. A. J. Silverside.

†Aruncus dioicus (Walter) Fernald *77, Lanarks.: Shiels, Glasgow, GR 26/52.66. Grassland. P. Macpherson & E. Teasdale, 1984, conf. E. J. Clement. Male plants. Ibrox, GR 26/55.64. Scrubby woodland. P. Macpherson, 1985. Female plants. Both **herb. P.M.** 1st and 2nd records.

211/1. Rubus chamaemorus L. *76, Renfrews.: Misty Low Range N.W. of Queenside Loch, GR 26/29.64. *Calluna* moor at 400 m altitude. H. Galbraith, 1971.

211/11/2. Rubus scissus W.C.R. Wats. *59, S. Lancs.: Withnell, GR 34/61.23. Moor. A. Newton & M. Smith, 1984, det. A. N.

211/11/139. Rubus procerus P. J. Muell. *76, Renfrews.: Between Paisley and Linwood, GR 26/46.65. Waste ground. A. McG. Stirling, 1981.

211/11/178. Rubus criniger (E. F. Linton) Rogers *59, S. Lancs.: Heapey Road, Heapey, GR 34/60.20. Roadside. A. Newton & M. Smith, 1984, det. A. N.

211/11/204. Rubus radula Weihe ex Boenn. *77, Lanarks.: Overtown, GR 26/80.52. A. McG. Stirling, 1981.

211/11/213. Rubus echinatoides (Rogers) Sudre *59, S. Lancs.: Birkacre, GR 34/57.15. Waste ground. A. Newton & M. Smith, 1984, det. A. N.

211/11/356. Rubus dasyphyllus (Rogers) Rogers *76, Renfrews.: Braidbar, Giffnock, GR 26/56.59. Waste ground. A. McG. Stirling, 1980.

†211/11/coc. Rubus cockburnianus Hemsley *77, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Side of old railway. P. Macpherson & E. Teasdale, 1983, **herb. P.M.**

211/11/new. Rubus newbouldii Babington *59, S. Lancs.: Withnell, GR 34/61.23. Moor. A. Newton & M. Smith, 1984, det. A. N.

211/11/rob. Rubus robii (W. C. R. Wats.) A. Newton *59, S. Lancs.: Coppull, GR 34/56.15. Sidings. A. Newton & M. Smith, 1984, det. A. N.

211/11/vill. Rubus villicauliformis A. Newton. *6, N. Somerset: Blackdown, Mendip, GR 31/48.57. Moorland. R. D. Randall, 1982, **herb. R.D.R.**, det. A. Newton.

†212/8. Potentilla norvegica L. 76, Renfrews.: Langbank, GR 26/38.73. T. Wise, 1905, **GL**. 2nd record.

†212/9. Potentilla intermedia L. *77, Lanarks.: Cambuslang, GR 26/63.60. Rough grassland. P. Macpherson & E. L. S. Lindsay, 1985, **herb. P.M.**, conf. R. J. Pankhurst.

212/14 × 15. Potentilla anglica Laichard. × P. reptans L. *80, Roxburghs.: Scaw Knowe, Ancrum, GR 36/62.25. Bare turf. R. W. M. Corner, 1985, **herb. R.W.M.C.**, det. B. Harold.

220/3/2 Alchemilla vestita (Buser) Raunk. *93, N. Aberdeen: Pitcaple, GR 38/73.26. Disused railway by wood. D. Welch, 1985, **ABD**.

†222/2. Sanguisorba canadensis L. 99, Dunbarton: Garscadden, GR 26/52.71. Waste ground. J. H. Dickson, 1984, **GL**. 2nd record.

†223/2. Poterium polygamum Waldst. & Kit. *70, Cumberland: Denton Holme, GR 35/39.50. Rough ground. R. E. Groom, 1985, **LANC**.

†227/2. Cotoneaster simonsii Bak. *77, Lanarks.: Linn, Glasgow, GR 26/58.58. River bank. P. Macpherson, 1984, **herb. P.M.**

†227/3. COTONEASTER HORIZONTALIS Decne. *77, Lanarks.: Shieldhall, Glasgow, GR 26/53.65. P. Macpherson, 1984, **herb. P.M.** 1st record of established population.

†227/bul. COTONEASTER BULLATUS Boiss. **44**, Carms.: Laugharne, GR 22/30.10. Wooded cliff. J. Rees & T. S. Crosby, 1985. 2nd record.

†231/lam. AMELANCHIER LAMARCKII F. G. Schroeder *70, Cumberland: E. of Thurstonfield Lough, GR 35/32.56. R. E. Groom, 1978, **LANC**. Beacon Hill, Penrith, GR 35/52.31. R. W. M. Corner, 1985, **LANC**. 1st and 2nd records.

232/5/3. SORBUS EMINENS E. F. Warb. **6**, N. Somerset: King's Wood, Yatton, GR 31/45.64. Wood. R. G. B. Roe, 1984, **herb. P.J.M. Nethercott**, det. P.J.M.N. 2nd record.

232/5/5. SORBUS PORRIGENTIFORMIS E. F. Warb. *5, S. Somerset: Yearnor Wood, Porlock, GR 21/84.48. Wood. J. Bevan & Lady R. FitzGerald, 1984, **CGE**, det. P. D. Sell & P. J. M. Nethercott.

†235/3. SEDUM SPURIUM Bieb. **38**, Warks.: Near Arley, GR 42/28.89. Concrete debris. J. Oliver, 1971, det. J. G. Hawkes. 2nd and earliest record.

†237/hel. CRASSULA HELMSII (T. Kirk) Cockayne *5, S. Somerset: Clapton Court, W. Crewkerne, GR 31/41.06. Ornamental pond. J. Ounsted, 1983.

†240/1. TELLIMA GRANDIFLORA (Pursh) Dougl. ex Lindl. *77, Lanarks.: Linn, Glasgow, GR 26/58.58. River bank. P. Macpherson, 1984, **herb. P.M.** Cambuslang, GR 26/63.61. River bank. E. L. S. Lindsay & P. Macpherson, 1985. 1st and 2nd records.

246/2. RIBES SPICATUM Robson *93, N. Aberdeen: Pitcaple, GR 38/73.26. Wood. D. Welch, 1985, **ABD**.

250/1. LYTHRUM PORTULA (L.) D. A. Webb **80**, Roxburghs.: Smailholm Craigs, GR 36/63.34. Pool in hollow. R. W. M. Corner, 1985, **herb. R.W.M.C.** 1st record since 1915.

251/1. DAPHNE MEZEREUM L. †*51, Flints.: Ddol Uchaf Nature Reserve, GR 33/1.7. Wood. B. Ing, 1985.

254/3 × 9. EPILOBIUM MONTANUM L. × E. OBSCURUM Schreb. *47, Monts.: Llwydiarth Hall, Aberllefenni, GR 23/77.10. Vegetable garden. P. M. Benoit *et al.*, 1985, **NMW**.

†254/6. EPILOBIUM CILIATUM Rafin. *93, N. Aberdeen: Gask, GR 38/72.47. Garden. D. Welch, 1984, **ABD**.

254/†6 × 3. EPILOBIUM CILIATUM Rafin. × E. MONTANUM L. *4, N. Devon: Cove, Bampton, GR 21/95.19. Roadside bank. L. J. Margetts, 1985, **herb. L. J. M.**

254/†6 × 4. EPILOBIUM CILIATUM Rafin. × E. LANCEOLATUM Seb. & Mauri *4, N. Devon: Cove, Bampton, GR 21/95.19. Rocky slope by road. L. J. Margetts, 1985, **herb. L.J.M.**

259/1. MYRIOPHYLLUM VERTICILLATUM L. **67**, S. Northumb.: Reigh Burn near Throckley, GR 45/14.65. Pond. G. A. & M. Swan, 1985, **herb. G.A.S.** 1st post-1930 record and most northerly English locality.

†AUCUBA JAPONICA Thunb. *44, Carms.: Gellideg, Llandyfaelog, GR 22/42.10. Wood. T. S. Crosby, 1985. 1st Welsh record.

†271/1. ASTRANTIA MAJOR L. *111, Orkney: North Walls, GR 39/27.89. Roadside. H. Smith, 1985.

272/2. ERYNGIUM CAMPESTRE L. †*5, S. Somerset: Hurstone Farm, Waterrow, GR 31/05.25. Pasture. R. G. Corns, 1984.

274/1. ANTHRISCUS CAUCALIS Bieb. **67**, S. Northumb.: Hadston Links, GR 46/27.00. G. A. & M. Swan, 1985, **herb. G.A.S.** 1st localized post-1930 record.

†274/3. ANTHRISCUS CEREFOLIUM (L.) Hoffm. *43, Rads.: Boughrood, GR 32/1.3. Roadside verge. T. G. Evans, 1985.

†280/1. Smyrnium olusatrum L. **70**, Cumberland: E. of Anthorn Chapel, GR 35/19.58. Open scrub by stream. R. E. Groom, 1984, **LANC**. 2nd record.

285/1. Apium graveolens L. ***77**, Lanarks.: Yorkhill, Glasgow, GR 26/55.66. River bank. P. Macpherson, 1985, **herb. P.M.**

285/4. Apium inundatum (L.) Reichb. f. **77**, Lanarks.: Carmunnock, Glasgow, GR 26/61.57. Reservoir. P. Macpherson, 1985. 2nd record.

286/2. Petroselinum segetum (L.) Koch ***49**, Caerns.: Bardsey Island, GR 23/1.2. P. M. Butler, 1933, det. A. J. Wilmott.

297/1. Berula erecta (Huds.) Coville ***98**, Main Argyll: Near Creagantairbh, GR 17/80.00. Slow-flowing stream. B. H. Thompson, 1984.

300/2. Oenanthe pimpinelloides L. ***35**, Mons.: Tynewydd N.W. of Bettws, GR 31/27.91. Roadside verge. T. G. Evans, 1985, **herb. T.G.E.** 1st Welsh record.

300/3. Oenanthe silaifolia Bieb. ***57**, Derbys.: Priestcliffe Lees, GR 42/15.72. N.-facing slope. G. & G. Wheeldon, 1985, **DBY**, det. A. Willmot.

311/†2 × 1. Heracleum mantegazzianum Somm. & Levier × H. sphondylium L. ***77**, Lanarks.: East Kilbride, GR 26/66.55. River bank. P. Macpherson & E. L. S. Lindsay, 1983. ***80**, Roxburghs.: Ormiston Mill, GR 36/70.27. Riverside. F. Stewart & J. Grace, 1976.

†319/6. Euphorbia dulcis L. ***98**, Main Argyll: Craignish Castle, GR 17/75.00. Shrubby bank. B. H. Thompson, 1984.

319/12. Euphorbia portlandica L. **11**, S. Hants.: Stanswood Bay, Calshot, GR 40/4.9. Shingle beach. R. P. Bowman & J. Venner, 1984. 1st post-1930 record.

320/1/4. Polygonum arenastrum Boreau. ***98**, Main Argyll: Glen Lochy, GR 27/20.25. Roadside verge. B. H. Thompson, 1984.

320/13. Polygonum mite Schrank **25**, E. Suffolk: North Cove, GR 62/47.90. Wet ride. F. W. Simpson, 1984. Only extant record. **68**, Cheviot: Detchant Pond, GR 46/08.36. G. A. Swan, 1985, **herb. G.A.S.**, det. J. R. Akeroyd. 2nd record.

320/14. Polygonum minus Huds. ***76**, Renfrews.: Pilmuir, Newton Mearns, GR 26/51.54. Loch margin. R. Mackechnie & P. Macpherson, 1975. 1st post-1930 record.

†320/19. Reynoutria japonica Houtt. ***111**, Orkney: Ramsdale Burn, Orphir, GR 57/34.01. Burnside, Kirkwall Bourgh, GR 57/45.11. Waste land. Both E. R. Bullard, 1983. 1st and 2nd records.

†320/20. Reynoutria sachalinense (F. Schmidt) Nakai ***76**, Renfrews.: Pollok, GR 26/54.62. Edge of wood. P. Macpherson, 1980, **herb. P.M.**

325/1/3. Rumex tenuifolius (Wallr.) Löve ***75**, Ayrs.: Bogside, Stevenston, GR 26/31.40. Sandy waste ground. A. McG. Stirling, 1979, **E**.

†325/5. Rumex alpinus L. ***93**, N. Aberdeen: Blairfowl, GR 38/81.38. Roadside. D. Welch, 1984, **ABD**.

325/8 Rumex longifolius DC. †**76**, Renfrews.: Cowglen, Glasgow, GR 26/54.61. Central reservation of road. P. Macpherson, 1983. 1st post-1930 record.

343/15. Salix phylicifolia L. ***93**, N. Aberdeen: Whinnyfold, GR 48/08.33. Coastal cliff. D. Welch, 1985, **ABD**.

343/16b. Salix repens L. subsp. argentea (Sm.) G. & A. Camus ***49**, Caerns.: Near Caernarfon, GR 23/4.6. G. C. Druce, 1919. Bardsey Island, GR 23/1.2. P. M. Butler, 1933, det. A. J. Wilmott. 1st and 2nd records.

358/4. Vaccinium oxycoccus L. ***93**, N. Aberdeen: Strathbogie, GR 38/47.23. Raised bog R. E. C. Ferreira & J. G. Roger, 1983.

358/5. Vaccinium microcarpum (Rupr.) Hook. f. *93, N. Aberdeen: Cairnbrallan, GR 38/33.24. Blanket peat. D. Welch, 1984, **ABD**.

†358/cor. Vaccinium corymbosum L. *11, S. Hants.: Ashley Heath, GR 41/10.04. Heath. R. P. Bowman, 1980, **herb. R.P.B.**, det. E. J. Clement.

359/1. Pyrola minor L. **52**, Anglesey: Newborough Forest, GR 23/4.6. Pine plantation. Mr & Mrs J. Davidson, 1984, **NMW**, det. R. H. Roberts & N. Brown. 1st record since 1813.

370/3. Lysimachia vulgaris L. ***109**, Caithness: Reisgill Burn, GR 39/24.35. Wet grassland. D. Wells, 1983.

371/1. Trientalis europaea L. **69**, Westmorland: Firbank Fell, GR 34/6.9. Under *Calluna*. T. & K. Wilson, 1985. 1st record since 1909.

372/4. Anagallis minima (L.) E. H. L. Krause **43**, Rads.: Road to Pentre Caeau, Llandeilo Graban, GR 32/08.44. Damp soil by stream. R. G. Woods, 1985, **NMW**. 2nd record. ***47**, Monts.: Manafon, GR 33/1.0. H. H. & S. Haines & R. D. Tweed, 1938.

387/1. Nymphoides peltata (S. G. Gmel.) Kuntze †***4**, N. Devon: Halberton, GR 31/00.13. Canal. B. Benfield & L. J. Margetts, 1984.

†390/1. Omphalodes verna Moench ***76**, Renfrews.: Rouken Glen Park, Glasgow, GR 26/54.58. Bank above stream. A. McG. Stirling, 1981, **E**.

392/6. Symphytum tuberosum L. †***52**, Anglesey: Marianglas, GR 23/50.84. Waste ground. R. H. Roberts, 1985.

†392/7. Symphytum grandiflorum DC. ***67**, S. Northumb.: Diptonfoot, GR 35/99.60. Wood. G. A. Swan, 1985, **herb. G.A.S.**

†Amsinckia intermedia Fischer & C. A. Meyer ***5**, S. Somerset: Taunton, GR 31/23.23. Golfcourse. T. T. Freeston, 1984. ***14**, E. Sussex: Malling Down, Lewes, GR 51/43.10. Disturbed ground. A. O. Chater, 1984, **BM**, det. M. Hyde.

400/8 umb. Myosotis arvensis (L.) Hill subsp. umbrata (Rouy) O. Schwarz ***76**, Renfrews.: Pollok estate, GR 26/54.61. Wood. A. J. Silverside, 1979, **herb. A. J. S.**

402/1. Mertensia maritima (L.) Gray **73**, Kirkcudbrights.: Dundrennan Army Range, GR 25/70.43. Shingle beach. D. Hawker, 1985. 1 plant. 1st record since 1882 record near here.

406/1 ros. Calystegia sepium (L.) R.Br. subsp. roseata Brummitt †***80**, Roxburghs.: Old station yard, Newcastleton, GR 35/48.87. Embankment. R. W. M. Corner, 1985, **herb. R.W.M.C.** Probably present since 1960 (cf. *Proc. bot. Soc. Br. Isl.* **6**: 290).

†406/2. Calystegia pulchra Brummitt & Heywood ***76**, Renfrews.: Road to Kerse, GR 26/33.55. Hedgerow. C. B. Pead & E. R. T. Conacher, 1981. ***93**, N. Aberdeen: Eden, GR 38/69.59. Grassland. D. Welch, 1985, **ABD**.

411/1. Hyoscyamus niger L. †**99**, Dunbarton: Duntocher, Glasgow, GR 26/49.71. Waste ground. A. McG. Stirling, 1985, **E**. 1st post-1930 record.

†413/nit. Solanum nitidibaccatum Bitter ***25**, E. Suffolk: Landguard Common, GR 62/28.32. Sandy shingle. A. Copping, 1983. Chillesford, GR 62/38.51. Red Crag pit. F. W. Simpson, 1984, det. A. C. Leslie. 1st and 2nd records.

416/7 × †pyr. Verbascum nigrum L. × V. pyramidatum Bieb. ***26**, W. Suffolk: Kentford Heath, Kennett, GR 52/70.68. Waste ground. G. M. S. Easy, 1971, **herb. G.M.S.E.**

†416/10. Verbascum virgatum Stokes **70**, Cumberland: Silloth, GR 35/11.53. N. Botham & M. Milne, 1985.

†416/pyr. Verbascum pyramidatum Bieb. ***26**, W. Suffolk: Kentford Heath, Kennett, GR 52/70.68. Waste ground. G.M.S. Easy, 1971.

†420/2. Linaria purpurea (L.) Mill. ***72**, Dumfriess.: Hightae, Lockerbie, GR 35/09.78. Disturbed ground. L. Kungu & M. E. R. Martin, 1984.

420/†2 × 3. LINARIA PURPUREA (L.) Mill. × L. REPENS (L.) Mill. ***48**, Merioneth: Penrhynedeudraeth, GR 23/61.38. By railway ballast. A. P. Conolly, 1983, **herb. A.P.C.**, det. C. A. Stace.

420/3. LINARIA REPENS (L.) Mill. †***75**, Ayrs.: Ardrossan B. P. Terminal, GR 26/22.42. Rock and gravel. B. Simpson, 1984.

420/3 × 4. LINARIA REPENS (L.) Mill. × L. VULGARIS Mill. ***47**, Monts.: Machynlleth railway station, GR 23/74.01. B. Gale *et al.*, 1985. ***75**, Ayrs.: Ardrossan B. P. Terminal, GR 26/22.42. Rock and gravel. B. Simpson, 1984.

422/2. KICKXIA ELATINE (L.) Dumort. †**43**, Rads.: Below Yr Allt, Llandeilo Graban, GR 32/08.44. Rubble. R. G. Woods, 1985, **NMW**. 2nd record.

†424/5. SCROPHULARIA VERNALIS L. ***32**, Northants.: Ferry Meadows, Peterborough, GR 52/15.98. Wood. S. Wells, 1982, **ABRN**.

†425/1 × 2 × var. MIMULUS GUTTATUS DC. × M. LUTEUS L. × M. VARIEGATUS Loddiges ***77**, Lanarks.: Near Carmunnock, GR 26/60.56. Streamside. P. Macpherson, 1985, **herb. P.M.**, det. A. J. Silverside.

†430/14. VERONICA PEREGRINA L. ***76**, Renfrews.: Newlands, Glasgow, GR 26/57.60. Garden weed. P. Macpherson, 1972, **herb. P. M.**, det. J. E. Lousley. Finlaystone House, GR 26/36.73. Nursery weed. A. J. Silverside, 1975.

430/20 hed. VERONICA HEDERIFOLIA L. subsp. HEDERIFOLIA ***4**, N. Devon: N. of Waytown Tunnel, Greenham, GR 31/07.19. Hedgebank. L. J. Margetts, 1984. Near Fairlynch Quarry, Braunton, GR 21/47.37. Hedgebank. W. H. Tucker, 1985. 1st and 2nd records.

430/20 luc. VERONICA HEDERIFOLIA L. subsp. LUCORUM (Klett & Richter) Hartl ***4**, N. Devon: Between Tidcombe and Manley Bridge, GR 21/98.12. Hedgebank. L. J. Margetts, 1984. ***76**, Renfrews.: Finlaystone estate, GR 26/36.73. Woodland path. A. J. Silverside, 1977.

435/1/13. EUPHRASIA NEMOROSA (Pers.) Wallr. ***77**, Lanarks.: Browncastle, GR 26/62.43. Heath. P. Macpherson, 1981, **herb. P. M.**, det. A. J. Silverside.

435/1/15 × 13. EUPHRASIA CONFUSA Pugsl. × E. NEMOROSA (Pers.) Wallr. ***35**, Mons.: Chepstow Park Wood, GR 31/50.98. Woodland path. T. G. & U. T. Evans, 1985, **herb. T. G. E.**, det. A. J. Silverside.

437/1. PARENTUCELLIA VISCOSA (L.) Caruel †**35**, Mons.: Bank of R. Usk, Llanbadoc, GR 31/37.99. S. J. Tyler, 1985, **herb. T.G. Evans**.

440/2. OROBANCHE PURPUREA Jacq. †***70**, Cumberland: Near Senhouse Dock, Maryport, GR 35/0.3. Waste ground. M. Milne, 1985, **LANC**, conf. D. J. Hambler.

440/4. OROBANCHE ALBA Steph. ex Willd. ***6**, N. Somerset: Berrow, GR 31/29.52. Fixed dunes. J. R. Comley, 1985.

440/10. OROBANCHE HEDERAE Duby ***13**, W. Sussex: N.W. of Chichester, GR 41/7.1. Parkland. Rev. E. A. Pratt, 1985, conf. M. Briggs.

440/11. OROBANCHE MARITIMA Pugsl. **4**, N. Devon: Croyde, GR 21/43.39. H. J. M. Bowen, 1984. 2nd record.

441/3. PINGUICULA VULGARIS L. **11**, S. Hants.: Acres Down, Lyndhurst, GR 41/2.0. Basic flush. A. Bolton, 1984. 1st post-1930 record.

441/4. PINGUICULA GRANDIFLORA Lam. †***48**, Merioneth: Brithdir near Dolgellau, GR 23/7.1. Basic boggy rill. P. M. Benoit, 1983, **NMW**. 1st Welsh record.

451/3. CALAMINTHA NEPETA (L.) Savi ***49**, Caerns.: South Shore, Llandudno, GR 23/7.8. F. T. Jones, 1930.

459/3. STACHYS ARVENSIS (L.) L. **93**, N. Aberdeen: Eden, GR 38/70.60. Turnip field. D. Welch, 1985, **ABD**. 1st post-1930 record.

462/1. LAMIUM AMPLEXICAULE L. *42, Brecs.: Glandulas, Llanafan Fawr, GR 22/94.53. Roadside verge. R. G. Woods, 1985, **NMW**.

462/2. LAMIUM MOLUCCELLIFOLIUM Fr. *52, Anglesey: Beaumaris, GR 23/60.76. Waste ground. R. M. Burton, 1985, **NMW**, conf. R. G. Ellis.

462/3. LAMIUM HYBRIDUM Vill. **93**, N. Aberdeen: Sandford Bay, GR 48/12.43. Grassland track. D. Welch, 1985, **ABD**. 1st post-1930 record.

†464/rus. PHLOMIS RUSSELLIANA (Sims) Bentham *85, Fife: Coultra, GR 37/35.32. Roadside. M. Benstead, 1981.

465/4/2 × 1. GALEOPSIS BIFIDA Boenn. × G. TETRAHIT L. *47, Monts.: Pont ar Byllfa, GR 23/89.12. Roadside bank. P. M. Benoit & M. Wainwright, 1985, **NMW**.

465/4/2. GALEOPSIS BIFIDA Boenn. *47, Monts.: Pont ar Byllfa, GR 23/89.12. Roadside bank. Ola Luest, Cwm Nant-y-Meichiaid, GR 33/12.14. Wood. Both P. M. Benoit & M. Wainwright, 1985. 1st and 2nd records. *77, Lanarks.: Shieldhall, GR 26/53.66. 1984. Sheils, Glasgow, GR 26/52.67. 1985. Both rough grass. P. Macpherson, **herb. P. M.** 1st and 2nd records.

469/2. SCUTELLARIA MINOR Huds. **51**, Flints.: Above Ffynnon Beuno, Tremeirchion, GR 33/0.7. Marsh. J. A. Green & G.Wynne, 1985. 2nd extant record.

472/2. PLANTAGO MEDIA L. †*111, Orkney: Graemshall, Holm, GR 57/48.01. E. Meek, 1984.

475/2. CAMPANULA TRACHELIUM L. †*77, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. By old railway. P. Macpherson & E. Teasdale, 1983, **herb. P. M.**, det. E. J. Clement.

†475/3. CAMPANULA RAPUNCULOIDES L. *5, S. Somerset: Ashill, GR 31/33.18. Railway cutting. W. L. Landsell, 1985, **herb. R.G.B. Roe**. *52, Anglesey: Baron Hill, Beaumaris, GR 23/5.7. A. J. Armitstead, 1926.

485/14. GALIUM PARISIENSE L. *25, E. Suffolk: Westleton, GR 62/45.69. Sandy heath. G. W. Maybury & E. Beaumont, 1985, **herb. E. M. & M. Hyde**.

†491/cae. LONICERA CAERULEA L. *57, Derbys.: Wye Dale, GR 43/09.72. Bank by R. Wye. L. Storer, 1985.

494/1. VALERIANELLA LOCUSTA (L.) Betcke **43**, Rads.: Knocklas Castle, GR 32/25.74. Shale below castle. J. & C. Port, 1984. 2nd record.

494/2. VALERIANELLA CARINATA Lois. *44, Carms.: Ammanford, GR 22/63.12. Chapel graveyard. A. M. Pell, 1985, **NMW**, det. R. G. Ellis.

495/1. VALERIANA OFFICINALIS L. subsp. SAMBUCIFOLIA (Mikan fil.) Čelak. *49, Caerns.: Dinas Duille, GR 23/4.5. Aberglaslyn, GR 23/5.4. Both N. Woodhead, 1929. 1st and 2nd records.

†CEPHALARIA GIGANTEA (Ledeb.) Bobrov **25**, E. Suffolk: Fen Lane, East Bergholt, GR 62/0.3. Laneside. I. Rose, 1984. 2nd record.

498/1. KNAUTIA ARVENSIS (L.) Coult. **98**, Main Argyll: Connel Airstrip, GR 17/90.36. Disused railway. P. Wormell, 1983.

502/1. BIDENS CERNUA L. **43**, Rads.: Near Cloggie, Llangunllo, GR 32/22.71. Edge of small pond. P. Richards, 1964. 2nd record.

†504/1. ARTEMISIA ARTEMISIIFOLIA L. **77**, Lanarks.: Shieldhall, GR 26/53.66. Waste ground. P. Macpherson, 1984, **herb. P.M.** 1st record since casual occurrence in 1919.

506/2 × 1. SENECIO AQUATICUS Hill × S. JACOBAEA L. *79, Selkirks.: Ettrick Water above Howden cauld, GR 36/44.27. Riverbank. *80, Roxburghs.: Ettrick Water above Overscloss, GR 36/47.30. Riverbank. Both R. W. M. Corner, 1983, **herb. R.W.M.C.**, det. D. R. McKean.

506/†4 × 7. SENECIO SQUALIDUS L. × S. VISCOSUS L. *32, Northants.: Wellingborough, GR 42/90.67. Old railway sidings. A. Robinson, 1983, **herb. A.R.**

†506/18. Senecio bicolor (Willd.) Tod. subsp. cineraria (DC.) A. O. Chater *46, Cards.: S. of Aberaeron harbour, GR 22/45.62. *Festuca rubra* sward on shingle. A. O. Chater, 1985.

506/†18 × 1. Senecio bicolor (Willd.) Tod. subsp. cineraria (DC.) A. O. Chater × S. jacobaea L. *47, Monts.: Felin-Gerrig, E. of Machynlleth, GR 23/76.00. Disturbed soil. C. A. Small, 1985, det. P. M. Benoit.

†506/ver. Senecio vernalis Waldst. & Kit. *29, Cambs.: Fen Drayton gravel pit, GR 52/34.69. Recently sown grass. G. M. S. Easy, 1985, **herb. G.M.S.E.**

†507/2. Doronicum plantagineum L. *32, Northants.: Between West Haddon and Long Buckley, GR 42/62.71. Roadside. I. Cameron, 1981. *43, Rads.: W. of Stow Bridge near Milebrook, GR 32/30.72. Wood. J. Roper, 1978. 70, Cumberland: W. of Penton Station, GR 35/43.76. Roadside. R. W. M. Corner, 1985, **LANC**. 2nd record.

†518/3. Solidago gigantea Ait. 77, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Clearing in scrub. E. Teasdale & P. Macpherson, 1984, **herb. P. M.**, det. A. J. Silverside. 2nd record.

519/1. Aster tripolium L. *77, Lanarks.: R. Clyde, Yoker, Glasgow, GR 26/53.66. A. McG. Stirling *et al.*, 1985. R. Clyde, Shieldhall, GR 26/53.66. P. Macpherson, 1985, **herb. P. M.** 1st and 2nd records.

526/3. Anthemis arvensis L. †99, Dunbarton: Clydebank, GR 26/49.70. Landscaped area. A. McG. Stirling, 1985, **E.** 1st record since 1891.

†533/3. Chrysanthemum maximum Ramond *77, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Waste ground. P. Macpherson & E. Teasdale, 1983.

539/1. Carduus tenuiflorus Curt. *75, Ayrs.: Horse Island, GR 26/21.42. Sandy ridge. B. Simpson, 1984.

540/4 × 3. Cirsium arvense (L.) Scop. × C. palustre (L.) Scop. *99, Dunbarton: Gartlea Farm, Gartocharn, GR 26/45.83. I. Christie, 1976, det. A. McG. Stirling.

550/3. Leontodon taraxacoides (Vill.) Mérat *93, N. Aberdeen: Fraserburgh, GR 48/00.65. Moist dunes. D. Welch, 1985, **ABD**.

555/1. Mycelis muralis (L.) Dumort. 79, Selkirks.: Corbielinn, Selkirk, GR 36/45.28. Wall-top. R. W. M. Corner, 1985. 2nd record.

558/1/45. Hieracium lasiophyllum Koch *44, Carms.: Craig Clyngwyn, GR 22/77.47. Base-rich cliffs. N.C.C. Field Unit, 1982.

558/1/56. Hieracium subrude (Arv.-Touv.) Arv.-Touv. *78, Peebless.: Windy Gowl, Stonypath, W. Linton, GR 36/14.54. Dry rocks. D. J. McCosh, 1979, **herb. D.J.McC.**, det. P. D. Sell.

558/1/83. Hieracium pseudosarcophyllum Pugsl. *77, Lanarks.: Lang Gill, Culter Fell, GR 36/04.27. Rocks by pool. D. J. McCosh, 1984, **herb. D. J. McC.**, det. P. D. Sell.

558/1/103. Hieracium stenstroemii (Dahlst.) Johans. *44, Carms.: Caeo, GR 22/67.39. Bridge parapet. I. M. Vaughan, 1965, **NMW**, det. J. Bevan.

558/1/125. Hieracium auratiflorum Pugsl. *83, Midlothian: Arthur's Seat, Edinburgh, GR 36/2.7. G. Taylor, 1934, **BM**, det. P. D. Sell & C. West.

558/1/133. Hieracium stenophyes W. R. Linton *78, Peebless.: Williamslee Burn, Leithen, GR 36/32.46. D. J. McCosh, 1981, **herb. D. J. McC.**, det. P. D. Sell.

558/1/144. Hieracium angustisquamum (Pugsl.) Pugsl. *46, Cards.: Nant Rhuddnant gorge, GR 22/80.78. Rocks by stream. A. O. Chater, 1984, **NMW**, det. P. D. Sell. 1st Welsh record. *57, Derbys.: Rowsley, GR 43/26.64. Bridge, disused railway sidings. R. Smith, 1985, **herb. R. S.**, det. D. J. McCosh & P. D. Sell.

558/1/206. Hieracium latobrigorum (Zahn) Roffey *78, Peebless.: Neidpath Castle, Peebles, GR 36/23.40. Basalt rocks near R. Tweed. D. J. McCosh, 1981, **herb. D.J.McC**., det. P. D. Sell.

558/1/222. Hieracium salticola (Sudre) Sell & West *44, Carms.: Cynghordy, GR 22/80.40. Railway embankment. I. M. Vaughan, 1965, **NMW**, det. J. Bevan. ***77**, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Waste ground. P. Macpherson & E. Teasdale, 1983, **herb. P. M.**, det. A. McG. Stirling.

558/1/223. Hieracium vagum Jord. ***76**, Renfrews.: Elderslie, GR 26/45.63. Waste ground. A.McG. Stirling, 1981, **E**.

†558/2/5. Hieracium flagellare Willd. ***77**, Lanarks.: Kenmuirhill, GR 26/66.60. Old pit bing. J. H. Dickson, 1985, **GL**.

†559/2. Crepis vesicaria L. subsp. taraxacifolia (Thuill.) Thell. **77**, Lanarks.: Linthouse, Glasgow, GR 26/54.66. Rough grassland. P. Macpherson, 1985, **herb. P.M.** 2nd record.

559/8. Crepis paludosa (L.) Moench **44**, Carms.: Valley of Afon Merchon, GR 22/73.41. Rock outcrops. P. Day, 1980. 2nd record, 1st since c. 1840.

†570/2. Elodea callitrichoides (Rich.) Casp. ***13**, W. Sussex: Chichester, GR 41/86.05. Canal basin. M. Fowler, 1979. Hunston, GR 41/86.02. Disused canal. M. Briggs, 1980. Both **LANC**. 1st and 2nd records, det. D. A. Simpson.

†571/1. Lagarosiphon major (Ridl.) Moss ***69**, Westmorland: Bankhead Pond, Helsington, GR 34/49.89. K. Raistrick, 1984, **LANC**, det. D. A. Simpson.

576/1. Zostera marina L. ***29**, Cambs.: River at Wisbech, GR 53/4.1. R. S. Adamson, 1908, **BM**, det. T. G. Tutin.

577/3. Potamogeton coloratus Hornem. ***11**, S. Hants.: The Moors, Bishop's Waltham, GR 41/56.16. Stream. F. Rose, 1984, **herb. A. Brewis**. **68**, Cheviot: Dunstanburgh, GR 46/25.22. Pond on golf links. G. A. & M. Swan, 1984, **herb. G.A.S.**, conf. N. T. H. Holmes. 1st record since 1847 record from Dunstanburgh.

577/16. Potamogeton trichoides Cham. & Schlecht. ***11**, S. Hants.: Mans Bridge, Southampton, GR 41/44.15. Old reservoir. R. P. Bowman, 1975, **BM**, det. J. E. Dandy.

577/20. Potamogeton filiformis Pers. **93**, N. Aberdeen: Cotehill Loch, GR 48/02.29. D. Welch, 1985, conf. N. T. H. Holmes. 1st post-1930 record.

580/1. Zannichellia palustris L. **43**, Rads.: Llynheilyn Pool, Llanfihangel-nant-Melan, GR 32/16.58. I. Soane & A. C. Powell, 1985, **NMW**. 2nd record.

†589/3 × 2. Polygonatum multiflorum (L.) All. × P. odoratum (Mill.) Druce ***77**, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Scrubby woodland. P. Macpherson & E. Teasdale, 1984, **herb. P.M.** ***99**, Dunbarton: West Helensburgh, GR 26/29.83. Railway embankment. R. R. Mill, 1967.

600/†2 × 1. Hyacinthoides hispanica (Mill.) Rothm. × H. non-scripta (L.) Chouard ex Rothm. ***77**, Lanarks.: Meikle Dripps near Glasgow, GR 26/57.55. River bank. P. Macpherson, 1984, **herb. P.M.**, conf. C. A. Stace.

†605/2. Juncus tenuis Willd. ***80**, Roxburghs.: Old station yard, Newcastleton, GR 35/48.87. Damp track bed. R. W. M. Corner, 1985, **herb. R.W.M.C.**

605/amb. Juncus ambiguus Guss. ***61**, S.E. Yorks.: Spurn, GR 54/42.15. Near Kilnsea Beacon Lane Pond, GR 54/41.18. Both F. E. Crackles & M. Nicholls, 1985, **herb. F.E.C.** 1st and 2nd records.

605/fol. Juncus foliosus Desf. ***44**, Carms.: Cilyblaidd, Pencarreg, GR 22/54.45. Wet pasture. BSBI meeting, 1985, **NMW**, det. R. G. Ellis.

605/15. Juncus acutus L. **11**, S. Hants.: Sandy Point, Hayling Island, GR 40/7.9. Saltmarsh. P. H. Colebourn, 1983. Only extant record.

605/18 × 19. JUNCUS ACUTIFLORUS Ehrh. ex Hoffm. × J. ARTICULATUS L. *14, E. Sussex: Chailey Common, GR 51/38.21. Boggy hollow. London N.H.S., 1984, det. B. R. Radcliffe.

606/2 × 1. LUZULA FORSTERI (Sm.) DC. × L. PILOSA (L.) Willd. *4, N. Devon: Withleigh, Tiverton, GR 21/91.11. Woodland bank. L. J. Margetts, 1985, **herb. L.J.M.**

606/3. LUZULA SYLVATICA (Huds.) Gaudin *25, E. Suffolk: Reydon, GR 62/47.78. Ancient woodland. P. G. Lawson, 1984, **herb. E.M. & M. Hyde**, conf. F. W. Simpson.

†606/4. LUZULA LUZULOIDES (Lam.) Dandy & Wilmott *47, Monts.: Powis Castle, GR 33/21.06. Grassy bank in wood. M. Wainwright, 1984, **NMW**.

607/1. ALLIUM AMPELOPRASUM L. *52, Anglesey: Near South Stack, GR 23/2.8. Field border. D. B. Hornby, 1975, conf. P. Day & R. H. Roberts.

607/3. ALLIUM SCORODOPRASUM L. *78, Peebless.: Near Kirklawhill, GR 36/08.37. Roadside. D. J. McCosh, 1985, **E**, conf. D. R. McKean.

607/6. ALLIUM OLERACEUM L. **5**, S. Somerset: Cleeve Hill, GR 31/05.42. Limestone grassland. R. G. B. Roe, 1985. 1st record since 1924.

†607/nig. ALLIUM NIGRUM L. *29, Cambs.: Milton gravel pits, GR 52/47.61. Waste ground. G. M. S. Easy, 1985, **herb. G.M.S.E.**

611/1. LEUCOJUM VERNUM L. †*29, Cambs.: Sheep's Green, Cambridge, GR 52/44.57. Damp ground near brook. P. F. Yeo, 1985.

†614/4. NARCISSUS × INCOMPARABILIS Mill. *77, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Bank. E. Teasdale & P. Macpherson, 1984, **herb. P.M.**, det. D. McClintock.

†614/ × bar. NARCISSUS × BARRII Baker *77, Lanarks.: Between Glasgow and Renfrew, GR 26/51.67. Bank. E. Teasdale & P. Macpherson, 1984, **herb. P.M.**, det. D. McClintock.

†616/2. IRIS VERSICOLOR L. *73, Kirkcudbrights.: New Galloway, GR 25/63.77. Stream under willows. D. McClintock, 1943. Rascarrel Bay, GR 25/80.45. Bog by shore. O. M. Stewart & M. McC. Webster, c. 1970. 1st and 2nd records.

616/3. IRIS FOETIDISSIMA L. †*99, Dunbarton: Cove, Loch Long, GR 26/22.82. Shore bank. A. McG. Stirling & A. Rutherford, 1984.

†618/spe. CROCUS SPECIOSUS Bieb. *17, Surrey: Chiddingfold, GR 41/96.35. Grassy churchyard. A. C. & J. F. Leslie & E. J. Clement, 1985, **herb. A.C.L.** Abundantly naturalized.

633/1. CORALLORHIZA TRIFIDA Chatel. *76, Renfrews.: Kilmacolm Moss, GR 26/36.69. Fen under trees. R. Kennedy, 1985, **herb. E.R.T. Conacher**.

638/2. PLATANTHERA BIFOLIA (L.) Rich. *111, Orkney: Sandwick, GR 57/21.14. Short cliff-top turf. C. & J. Booth, 1985, conf. J. J. Wood.

642/7 × 5. ORCHIS MASCULA (L.) L. × O. MORIO L. *69, Westmorland: Hazelslack, Arnside, GR 34/4.7. Limestone pasture. M.T.Y. Foley, 1985, det. J. J. Wood.

643/1 × 5. DACTYLORHIZA FUCHSII (Druce) Soó × D. PURPURELLA (T. & T. A. Stephenson) Soó *77, Lanarks.: Shiels, Glasgow, GR 26/52.65. Damp scrub. E. Teasdale & P. Macpherson, 1985, **herb. P.M.**

643/2b × 5. DACTYLORHIZA MACULATA (L.) Soó subsp. ERICETORUM (E. F. Linton) P. F. Hunt & Summerhayes × D. PURPURELLA (T. & T. A. Stephenson) Soó *77, Lanarks.: Near Coulter, GR 36/0.3. D. J. McCosh, 1967.

643/3. DACTYLORHIZA INCARNATA (L.) Soó *93, N. Aberdeen: Corsemaul, GR 38/39.40. Flush. D. Welch, 1984, **ABD**.

643/6. DACTYLORHIZA MAJALIS (Reichenb.) P. F. Hunt & Summerhayes subsp. OCCIDENTALIS (Pugsl.) Sell *109, Caithness: Near Thurso Castle, GR 39/12.68. Neutral grassland. J. K. Butler, 1983, **E**, det. R. H. Roberts.

†646/1. ACORUS CALAMUS L. *46, Cards.: S.W. of Hendy, Highmead, GR 22/49.42. Overgrown pond in copse. A. O. Chater, 1985.

†649/2 ita. ARUM ITALICUM Mill. subsp. ITALICUM **73**, Kirkcudbrights.: Munches, GR 25/83.58. O. M. Stewart, 1985. 2nd record. ***99**, Dunbarton: Dunglass Castle, Bowling, GR 26/43.73. Rocky slope. A. McG. Stirling, 1972. Near Knockderry, Cove, GR 26/21.83. *Reynoutria* thicket. A. McG. Stirling & A. Rutherford, 1983, **E**. 1st and 2nd records.

665/9. SCHOENOPLECTUS TABERNAEMONTANI (C. C. Gmel.) Palla **98**, Main Argyll: Bagh Ban, Craignish, GR 17/75.00. Seaward edge of swamp. B. H. Thompson, 1984, **herb. B.H.T.**

656/2. ELEOCHARIS ACICULARIS (L.) Roem. & Schult. **76**, Renfrews.: Loch Libo, GR 26/43.55. Sandy loch bay. A. J. Silverside, 1979. First post-1930 record.

656/6. ELEOCHARIS UNIGLUMIS (Link) Schult. ***5**, S. Somerset: West Sedge Moor, GR 31/35.26. By rhine. R. S. Cropper, 1984, **herb. R.G.B. Roe**.

658/1. CYPERUS LONGUS L. **49**, Caerns.: Criccieth, GR 23/50.37. Wet unstable cliff. L. J. Larson, 1985, **NMW**. 2nd record.

663/2. CAREX DISTANS L. ***99**, Dunbarton: Mambeg, Gare Loch, GR 26/23.89. Rocks on shore. A. McG. Stirling, 1985, **E**.

663/8 × 4. CAREX DEMISSA Hornem. × C. HOSTIANA DC. ***47**, Monts.: E. of Pont Crugnant, GR 23/89.95. Boggy rill. P. M. Benoit *et al.*, 1985.

663/10. CAREX SEROTINA Mérat **25**, E. Suffolk: Lound, GR 63/50.00. Edge of ponds. F. W. Simpson, 1984. 2nd extant record.

663/11. CAREX EXTENSA Gooden. ***76**, Renfrews.: Cardwell, GR 26/20.74. Saltmarsh turf. A. McG. Stirling, 1979.

663/12. CAREX SYLVATICA Huds. **93**, N. Aberdeen: Meet Hill, Peterhead, GR 48/11.44. Wood. D. Welch, 1984, **ABD**. 2nd extant record.

663/20. CAREX RIPARIA Curt. **69**, Westmorland: N.W. of Kirkby Stephen, GR 35/74.13. Rough pasture. K. Raistrick, 1985, **LANC**, conf. A. O. Chater. 1st post-1930 record.

663/28. CAREX LIMOSA L. **93**, N. Aberdeen: Strathbogie, GR 38/47.23. Flushed mire. R. E. C. Ferreira & J. G. Roger, 1983. 1st post-1930 record.

663/35. CAREX ERICETORUM Poll. ***32**, Northants.: Barnack Hills and Holes, GR 53/07.04. Limestone grassland. P. S. Lusby, 1978.

663/47. CAREX ACUTA L. **50**, Denbs.: R. Clwyd near Denbigh, GR 33/08.65. Edge of ditch. J. A. Green, 1985, **NMW**, det. A. O. Chater. 2nd record.

663/67. CAREX SPICATA Huds. ***46**, Cards.: Cors Caron, E. of Cruglas, GR 22/70.65. Verge of disused railway. A. O. Chater, 1985, **NMW**, det. A. O. C. & R. W. David.

663/72 × 73. CAREX CURTA Gooden. × C. LACHENALII Schkuhr **92**, S. Aberdeen: Cairn Toul, GR 27/95.97. D. J. Tennant, 1975, **BM**, conf. A. O. Chater & R. W. David. 2nd v.c. and British record.

663/73. CAREX LACHENALII Schkuhr **92**, S. Aberdeen: Record published in *Watsonia* **15**: 404 is not only extant record.

†ARUNDINARIA JANSAURENSIS Gamble ***46**, Cards.: S.W. of Highmead mansion, GR 22/49.43. Damp woodland by pond. A. O. Chater, 1985, **NMW**, det. D. McClintock. 1st Welsh record.

670/1 × †671/2. FESTUCA PRATENSIS Huds. × LOLIUM MULTIFLORUM Lam. ***17**, Surrey: Between Old Woking Sewage Works and Newark, GR 51/03.57. By path in meadow. R. & N. Sherlock, 1985, **herb. A. C. Leslie**, conf. A.C.L. ***61**, S.E. Yorks.: N.E. of Firby, GR 44/75.66. E. Chicken, 1985, det. T. A. Cope.

670/3 × 671/1. FESTUCA GIGANTEA (L.) Vill. × LOLIUM PERENNE L. *29, Cambs.: Balsham, GR 52/59.51. Meadow. P. J. O. Trist, 1974, **herb. P.J.O.T.**

670/5. FESTUCA HETEROPHYLLA Lam. *69, Westmorland: Appleby Castle, GR 35/68.19. Woodland above R. Eden. R. E. Groom, 1985, **LANC**.

670/6. FESTUCA RUBRA L. subsp. MEGASTACHYS Gaudin *76, Renfrews.: Williamwood, GR 26/56.58. P. Macpherson, 1978, **herb. P. M.**, det. C. E. Hubbard.

672/3. VULPIA MYUROS (L.) C. C. Gmel. *77, Lanarks.: King George V dock, Glasgow, GR 26/53.66. P. Macpherson & E. L. S. Lindsay, 1985, **herb. P. M.** Bunhouse, Glasgow, GR 26/56.66. Old bridge. J. H. Dickson, 1985, **GL**. 1st and 2nd records.

673/1 × 5. PUCCINELLIA MARITIMA (Huds.) Parl. × P. RUPESTRIS (With.) Fernald & Weatherby *11, S. Hants.: R. Test, Nursling, GR 41/36.14. Brackish pasture. R. P. Bowman, 1977, **herb. R.P.B.**, det. A. Melderis.

673/2. PUCCINELLIA DISTANS (L.) Parl. *32, Northants.: Wansford, GR 52/07.99. Roadside verge. N. E. Scott, 1980.

676/11. POA ANGUSTIFOLIA L. *76, Renfrews.: Dunrod near Inverkip, GR 26/22.72. Near Quarriers Homes, GR 26/37.66. Both Railway. I.T.E. Railway Survey, 1980. 1st and 2nd records.

676/12. POA SUBCAERULEA Sm. 76, Renfrews.: Barrangary near Bishopton, GR 26/44.69. Railway. I.T.E. Railway Survey, 1980. 2nd record.

†676/15. POA CHAIXII Vill. *93, N. Aberdeen: House of Daviot, GR 38/74.27. Policy woodland. D. Welch, 1984, **ABD**.

683/13. BROMUS LEPIDUS Holmberg 77, Lanarks.: Cadder, Glasgow, GR 26/61.72. Riverside path. B.S.B.I./Glasgow N.H.S. Field Meeting, 1982, **herb. P. Macpherson**, conf. P.J.O. Trist. 2nd record.

683/10 × 13. BROMUS HORDEACEUS L. × B. LEPIDUS Holmberg *77, Lanarks.: East Kilbride, GR 26/66.55. Edge of meadow. P. Macpherson & E. L. S. Lindsay, 1983, **herb. P. M.**, det. P. J. O. Trist.

†683/jap. BROMUS JAPONICUS Thunb. *70, Cumberland: Silloth, GR 35/1.5. E. J. Glaister, 1877, **CLE**, det. P. M. Smith.

685/3 × 5. ELYMUS FARCTUS (Viv.) Runemark ex Melderis × E. REPENS (L.) Gould *69, Westmorland: Newbiggin, GR 34/26.69. Sandy shore. *70, Cumberland: Beckfoot, Silloth, GR 35/09.49. Sandy gravel. Both G. Halliday, 1978, **LANC**, det. A. Melderis.

685/5. ELYMUS PYCNANTHUS (Godron) Melderis *67, S. Northumb.: N. Blyth, GR 45/31.82. Sand dune. G. A. Swan, 1978, **herb. G.A.S.**, conf. T. G. Tutin.

†687/jub. HORDEUM JUBATUM L. *77, Lanarks.: Provanmill, Glasgow, GR 26/62.66. Roadside. J. H. Dickson, 1982, **GL**.

†692/2. AVENA LUDOVICIANA Durieu *76, Renfrews.: Near Inchinnan, GR 26/4.6. J. H. Penson, 1970, **herb. J.H.P.**

700/1. CALAMAGROSTIS EPIGEJOS (L.) Roth 46, Cards.: W.S.W. of Traeth y Mwnt, GR 22/19.51. Grassy sea cliff. A. O. Chater, 1985, **NMW**. 2nd record. *98, Main Argyll: S. of Bagh Ban, Craignish, GR 17/75.00. Bushy cliff. B. H. Thompson, 1984.

†701/7. AGROSTIS SCABRA Willd. *76, Renfrews.: Govan Docks, GR 26/57.64. Old railway yards. A. J. Silverside & C. Tavendale, 1977, **E**. Well established.

707/1. PHLEUM BERTOLONII DC. *99, Dunbarton: Near Cardross Station, GR 26/34.77. Sandy ground near shore. A. McG. Stirling & A. Rutherford, 1985, E.

708/4. ALOPECURUS AEQUALIS Sobol. *5, S. Somerset: Scott's Nurseries, Merriott, GR 31/44.12. Damp ground. R. G. B. Roe, 1985, **herb. R.G.B.R.**

708/5 × 3. ALOPECURUS BULBOSUS Gouan × A. GENICULATUS L. ***11**, S. Hants.: R. Test, Nursling, GR 41/3.1. Brackish pasture. R. P. Bowman, 1980, **K**, det. T. A. Cope. 1st British record.

709/1. MILIUM EFFUSUM L. **93**, N. Aberdeen: Blairfowl, GR 38/80.38. Wet woodland. D. Welch, 1984, **ABD**. 2nd record.

†713/4. PHALARIS PARADOXA L. var. PRAEMORSA Coss. & Dur. ***26**, W. Suffolk: Hawkedon, GR 52/79.51. Wheat field. Boxted, GR 52/80.50. Barley field. Both M. A. Hyde, 1985, **herb. E. M. & M. Hyde**. 1st and 2nd records, former conf. E. J. Clement.

714/2. PARAPHOLIS INCURVA (L.) C. E. Hubbard ***49**, Caerns.: Porth Ysgaden, GR 23/21.37. Eroding drift above beach. J. R. Akeroyd, 1985, **RNG**, conf. C. A. Stace.

Book Reviews

Bee Orchids (3). Stephen Blackmore. Pp. 24, with 12 colour & 8 black & white illustrations. 1985. Price £1·25 (ISBN 0–85263–745–4). *Buttercups* (6). Stephen Blackmore. Pp. 24, with 13 colour and 7 black & white text illustrations. 1985. Price £1·25 (ISBN 0–85263–763–2). *Willows of the British Isles* (8). Theresa Brendell. Pp. 24, with 16 colour and 14 black & white text illustrations. 1985. Price £1·25 (ISBN 0–85263–765–9). Shire Natural History Series. Shire Publications Ltd, Aylesbury.

These A5-sized, glossy paperbacks are, it is hoped, the first in a long line of botanical 'mini-monographs' of groups of plants found in the British Isles. The publishers define the aim of this new series, which also covers zoological topics, as "to fill the gap between brief guides of general interest and full-length books for the specialist . . . for the interested layman or student". They combine informative accounts of the biology of each group with an identification guide.

Bee Orchids covers the four *Ophrys* species found in this country. Few ordinary folk have ever seen a wild orchid in this country, but they will all have heard of the Bee Orchid. This little guide with its intimate details of life history, including the latest data on the nature of the association with mycorrhizal fungi and the bizarre pollination mechanism of the Bee Orchids – which actually emit pheromones to attract their male insect pollinators, as well as visually resembling their mates – is sure to enthral both layman and dedicated botanist alike. The side-by-side sketches and colour photographs should ensure accurate identification of the various *Ophrys* species and their varieties. Why no colour plate of the Late Spider Orchid (*O. fuciflora*), which some people confuse (perhaps fortunately) with the Bee?

Buttercups deals with our members of the genus *Ranunculus*. The yellow-flowered species are dealt with in some detail, the white-flowered ones more cursorily. The chatty comparative narrative of these guides with accurate side-by-side line drawings and character tables would have been the ideal mode for sorting out the difficult water crowfoots. To claim that infertility in *R. ficaria* subsp. *bulbifera* is due to tetraploidy *per se* is misleading, and obscures a fascinating if as yet speculative story. These are topics, perhaps, for an expanded second edition, and their omission is no reason to decry a splendid account of our buttercups – a must for all school biology libraries.

Willows compliments nicely the B.S.B.I.'s own *Willows & Poplars* and gently introduces both layman and perplexed botanist alike to our willows. It has an excellent character-matrix key for identification and colour photographs of whole-tree and branch closeups. Side-by-side leaf outlines of all the species and colour shots of more catkins would be a welcome inclusion for a later edition, as the willows are perhaps more likely to appeal to the discerning layman.

These and future botanical booklets in the series should be in all 6th form libraries. They form the ideal medium for introducing the recreational pleasure that field botany can bring to young receptive minds.

K. J. Adams

Cambridge and Clare. Sir Harry Godwin. Pp. xxi + 230, with 43 black & white illustrations. Cambridge University Press, Cambridge. 1985. Price £19·50 (ISBN 0–521–30765–1).

In the last few years there has been a sudden rush of books on Cambridge botany and botanists, greatly enriching our knowledge of the more recent periods in particular. First came the collective tribute to Humphrey Gilbert-Carter by some of his past pupils and friends, then the similar volume in memory of the late John Raven, then the history of the Botanic Garden by its then Director, Max Walters. Now the late Sir Harry Godwin has given us his memoirs of his sixty-odd years in residence – to the best of my knowledge the first former occupant of a British botanical chair to have published an autobiography, at any rate of book length, since F. O. Bower in 1938.

As the title indicates, the book is addressed to two overlapping readerships: to past and present members of Clare College (of which Sir Harry was successively an undergraduate, research student and Fellow) and to those interested in the University's history in general and in its botanical teaching in particular. This dual aim was perhaps over-ambitious, for satisfying the one lot of readers must inevitably have meant disappointing in some degree the other, in view of the fact that (doubtless by decree of the publisher) the book is a comparatively short one. As it is, much of the matter can hardly help but be prohibitively parochial to anyone not of the College, who would surely have preferred much more on the author's botanical career and to have had the benefit of his reflections on how the discipline has developed.

Nevertheless what we are given on botany is full of interest, even though it touches on the concerns of this Society only tangentially. For while Sir Harry was always a field man, it was ecology and Quaternary studies, never taxonomy and only indirectly floristics, that held his allegiance. Even so, B.S.B.I. members predictably crop up here and there in his pages. Our first President, John Gilmour, was, for example, his first pupil when he embarked on College 'supervisions' (Cambridge for tutorials), and the Demonstrator for his early first-year practical classes turns out to have been none other than Dr Cyril West. Another with whom the author literally rubbed shoulders – for he was one of the outsider M.A.s with dining rights in Clare – was the author of that pre-war Flora of Cambridgeshire and specialist in *Arctium*, A. H. Evans. Evans, we learn, was crippled by locomotor ataxia and in his later years depended on undergraduates to do the collecting that nourished his final passion, *Rubus*.

As one of the more towering of his early colleagues and co-nurse of the infant British Ecological Society, Sir Arthur Tansley expectedly features prominently – indeed has a whole chapter to himself. Tribute is paid to him, *inter alia*, as a superlative editor and as the possessor of "remarkable powers of timely innovation." The two were additionally brought together by a shared interest in psychoanalysis. Tansley's fascination with that newly-emergent field of knowledge went so far indeed that in 1923, taking advantage of his private means, he resigned his University post and went to live with his family in Vienna in order to study under Freud. Tansley, the founder of the *New Phytologist*, was subsequently the author of *The New Psychology*, a minor bestseller in its day. Fortunately for botany, however, that proved only a passing phase and a mere four years later he was back in academic harness, summoned by Oxford to the Sherardian Chair. On arriving at Oxford he was soon quarrelling bitterly with G. C. Druce, for reasons that still remain obscure (Sir Harry, regrettably, is silent on the matter), and as a result was permanently alienated from 'Druce's society', the B.S.B.I.'s ancestor, the B.E.C.

Much the most intriguing revelation in the book is the extraordinary paranoia with which one of Sir Harry's predecessors in the Cambridge Chair, F. T. Brooks, was afflicted. So violent was the animosity Brooks felt towards his Professor, Sir Arthur Seward, that he once went so far as to denounce him to the police as a German spy. For years it was quietly accepted among their colleagues that on no account could the two be left alone in a room together. Yet despite his notorious instability Brooks was appointed Seward's successor and went on to head the department for the next twelve years. It is just such quirks of personality, such chance conjunctures of individuals, that account for so many of the otherwise inexplicable twists and turns of history, and it is to autobiographers above all that we look to reveal them.

Sir Harry's life was clearly an enviably happy and productive one. From comparatively humble origins he emerged, under the wing of the customary influential schoolteacher, to pursue the academic career as an ecologist that he had resolved upon even ahead of his arrival at university. It would surely have been a successful career whatever direction it had taken. All students of floristics, however, must ever be grateful that, eight years into teaching and research, he was guided by Tansley (or rather, initially, his wife was) into the then-virgin field in Britain of pollen analysis. The rest is history – or, to be specific, *The History of the British Flora*. He needs no other monument than that.

D. E. ALLEN

The Victorians and their flowers. Nicolette Scourse. Pp. 195, with 17 colour plates, 102 black & white text illustrations and 1 table. Croom Helm, London and Canberra. 1983. Price £12·95 (ISBN 0–7099– 2377–5).

Anyone who has had the mischance to borrow, buy or be given Lynn Barber's *The Heyday of Natural History* will find this book a refreshing antidote. Both authors have similarly fallen under the spell of those popular illustrated works that survive in such numbers from the Victorian era and that seem so peculiarly redolent of the ideas and attitudes of the age; but where the one felt obliged to scoff and to jeer the other approaches her subject with evident admiration and sympathy. The product of wide reading and with numerous well-chosen illustrations, this attractive new contribution to what might be termed '*Saturday Book* social history' will deservedly be a much-favoured choice for presents.

Like so many members of that genre, though, it is essentially a confection, made out of material that has been forced into an unreal shape. For it is founded on a fallacy: that there exists a single entity, the admiration-cum-study of flowers, of which field botany and horticulture merely form scarcely distinguishable facets. In reality, of course, the two are largely discrete and, even though they spring from the same tap-root, have long developed independently of one another. The garden wall is a very solid dividing-line and it is idle to pretend otherwise. By disregarding its existence, the author has produced a book which, inasmuch as it keeps almost entirely to the horticultural side of the wall, is strictly speaking of very limited relevance to the field botanist reader. The main exception is Chapter Five, in which extensive recourse is had to the journals and superb herbarium (sample sheets from which are reproduced as illustrations) of Robert Dick, the poverty-stricken Thurso baker who first detected *Hierochloë borealis* in Britain.

But perhaps it was wise for the author to penetrate into our territory no further than this, for once at the limits of her reading her touch noticeably falters. On page 139, for example, we are told that "museums only came into being after the Great Exhibition in 1851 – the Natural History Museum in London only being opened in 1881 – and natural history was not taught in schools until the 1880s." There are three misleading statements there in that single sentence alone. What a pity the text was not submitted to the scrutiny of a specialist. What a pity, too, that a book that is otherwise so pleasing visually should have had the captions to two of the figures (5.6 and 5.16) transposed so obtrusively.

D. E. Allen

The names of plants. D. Gledhill. Pp. viii + 159. Cambridge University Press, Cambridge. 1985. Prices: paperback £6·95 (ISBN 0–521–31562–X); hard covers £20·00 (ISBN 0–521–30549–7).

This small book, not unreasonably priced as a paperback, is in two parts. The first 48 pages are a history of the naming of plants, concentrating on the Latin names and the development of the rules of nomenclature. The account of nomenclature up to Linnaeus is an interesting summary, but the exposition of the current International Code of Botanical Nomenclature is very confusing and unlikely to enlighten readers. Although, for example, Wardian cases and chromosomes are described in some detail, illegitimate names are mentioned only in a misleading aside. Errors abound, from Linnaeus's *Systema Naturalis* (*vice Naturae*) to a statement that the name Papilionaceae refers to the flowers being adapted to pollination by butterflies. Most of the references in the text, e.g. Grew (1672) and Sutton (1902), are not in the Bibliography, and one of the few that seems to be, Farr (1980), is given there as Farr (1979).

The rest of the book is a sensibly constructed glossary, mostly of generic and specific names, and of elements used to make up such names; thus a large number of names can be interpreted by looking up their constituent parts. Its potential usefulness to B.S.B.I. members is indicated by the fact that 90% of the first 300 names of angiosperms in A. R. Clapham, T. G. Tutin & E. F. Warburg, *Excursion Flora of the British Isles*, 3rd ed. (1981) are covered by it, more than in any other currently available glossary. This is in spite of the statement by the author that he has in general omitted commemorative and geographical epithets and anagrams. But he also says "I make no claim that the meanings which I have listed are always the only meanings which have been put upon the various entries", and this leads to one of the chief drawbacks of the book. He is so partial in some of the meanings that the results are very misleading, e.g. "*fluitans* floating on water", "*natans* floating under water"; "*aquaticus* growing in water", "*aquatilis* growing under water". These antitheses are entirely spurious. In other cases, e.g. "*runcinatus* saw-toothed, sharply cut", the essential definition, in this instance that the teeth or lobes point towards the base of the organ, is missing. Some words are quite wrongly translated, *quadratus* for example does not mean "into four, in fours" but square or rectangular. It is startling to see under the Cambridge imprint "*saepius-a-um* of hedges"; *saepius* of course means more often, and only *saepium* or *sepium* is the genitive plural of *saepes* or *sepes*, a hedge.

With thorough editing this book could have been useful, but as it is it cannot be recommended. For an exposition of nomenclature, C. Jeffrey, *Biological nomenclature* (1973), is a model of clarity and helpfulness, but for a glossary there seems to be nothing entirely satisfactory currently in print.

A. O. Chater

The English landscape past, present and future. Edited by S. R. J. Woodell. Pp. x + 240, with 43 black & white photos and 56 text figures. Oxford University Press, Oxford. 1985. Price £15·00 (ISBN 0–19–211621–5).

This book is the text of the 1983 Wolfson College Lectures and consists essentially of brilliantly written review chapters on many of the factors that shape the English landscape. It expounds recent ideas that may in many cases be unfamiliar to the general botanical reader and forms probably the best up-to-date introduction to the subject. The chapter by O. Rackham on ancient woodland and hedges, lucidly summarizing his own and others' work on these features, will be of particular value to botanists. He begins by deploring that it is still necessary to refute the myth that our present hedged and walled landscape is the result of eighteenth and nineteenth century agriculture changes, and ends by indicating that this landscape is vastly older than most of us realize, the Romans and their predecessors having reduced well over half of England to farmland and moorland, so that the Anglo-Saxons probably took over an at least partly hedged landscape. B. W. Cunliffe, in the chapter on man and landscape 6000 BC–AD 400, even refers to the British landscape at the end of the Roman period as "over-used". The chapter on the geomorphological background by D. K. C. Jones contains a Landsat image of the area from Bournemouth to Builth Wells under snow, showing the underlying structural features with astonishing clarity, and this alone is almost worth the price of the book. (Some of the other illustrations, notably photographs of Bamford Edge and of a South Downs dry valley, are of quite deplorable quality.) Joan Thirsk, in an account of fads and fashions in the agricultural landscape, tells us that rapeseed, which many consider today a garish and unwelcome novelty, was warmly welcomed and widely cultivated here in the sixteenth century and continued into the early nineteenth century. Among other crops whose history she recounts are various dye plants. A madder (*Rubia tinctoria*) plantation at Deptford in 1660 was said to employ 1000 people, and several hundred acres of safflower (*Carthamus tintorius*) were growing in Oxfordshire in 1673.

The history of our climate and its effect on the landscape is described by H. H. Lamb with a mass of illustrative detail, and when we learn, for example, that in the late seventeenth century the growing season at Oxford was probably 3–5 weeks shorter than in the warmest decades of the present century, we can understand why he warns us to understand well what we attempt to conserve "because conservation is often not nature's way". A tentatively optimistic final chapter by M. E. D. Poore on the present state of agriculture, forestry and conservation, with some emphasis on the effects of E.E.C. policy, is somewhat countered by the epilogue. In this the editor suggests that although earlier chapters have shown that our landscape has undergone more changes, and reflects much more of the past, than we previously realized, today's changes are so drastic that the future, unlike the past, probably really does have in store loss and impoverishment rather than evolution and enrichment.

A. O. Chater

Riches of the rain forest. An introduction to the trees and fruits of the Indonesian and Malaysian rain forest. W. Veevers-Carter. Pp. 103, with c. 22 line drawings and 12 colour plates. Oxford University Press, Singapore. 1985. Price £13·50 (ISBN 0–19–582576–4).

The author, dedicating this slim book to the memory of the Dutch conservationist, Marius Jacobs, has attempted to illustrate the richness of the Malesian rain forests not in terms of diversity alone but also in relation to the economic products obtained from the wild. She has used the examples to develop a passionate plea for conservation. There is a foreword by Md. Khir Johari, President of W.W.F. Malaysia stressing the timely appearance of the book and its value as non-academic publicity for the cause of conservation. Fifteen short chapters or essays deal with particular plant groups, their natural history and their economic importance: dipterocarps, figs, rattans, ironwood (*Eusideroxylon* spp), *Eugenia* spp, nutmegs, rambutans and relatives, durians, *Artocarpus* spp, *Agathis*, *Rafflesia*, climbers, orchids and *Pinus*. There is an epilogue commenting on forest dwellers, and a glossary. There are twelve slightly 'primitive' colour plates and several line drawings prepared by the Indonesian artist, Md. Anwar.

There is much to praise in this book. It is clearly written and focusses attention directly on some of the most important problems in the exploitation of Malesian rain forest. The choice of examples is good but there are some unfortunate generalizations and inaccuracies, the most glaring of which is the statement that curare comes from a species of Menispermaceae rather than *Strychnos* in Loganiaceae. The account of the Dipterocarps is spoiled by the oversimplified statement concerning stocks of these trees. Anyone in Peninsular Malaysia can still see many dipterocarps within 30 km of the centre of Kuala Lumpur, thus undermining the credibility of the author's message concerning over-exploitation.

For whom is the book intended? The author states it is written for the layman, but whether in Europe or South East Asia it is not clear. The price is much too high if it was intended for an Indonesian market. Beautiful though the production is, I feel the cause of conservation would have been more compellingly served with a more dynamic book design, the use of photographs and, if possible, a lower price.

J. DRANSFIELD

The wildlife of the Thames Counties, Berkshire, Buckinghamshire and Oxfordshire. Edited by Richard Fitter. Robert Dugdale in association with Berkshire, Buckinghamshire and Oxfordshire Naturalists' Trust, Oxford. 1985. Price £4·95.

Eleven contributors under the skilful editorship of naturalist and wildlife author (and former B.B.O.N.T. president) Richard Fitter makes this an authoritative book with something for everybody interested in this part of the Thames Valley. Richard Fitter opens with a chapter entitled 'The Physical Background and the Influence of Man', John M. Steane contributes 'Land Use History' and S. R. J. Woodell 'Vegetation'. H. J. M. Bowen's chapter, 'The Flora', follows with notes on interesting species and their localities. I found this chapter particularly gripping reading, wanting to set off and visit the interesting plants and sites immediately! It includes bryophytes, lichens, fungi and even algae. Pages 70–161 are then devoted to animals. After this come smaller chapters on 'Conservation Achievements and Problems' by Richard Fitter (very much a history of conservation bodies and B.B.O.N.T.), 'A Note on Environmental Education' by Ursula Bowen, and finally 'The Warburg Reserve, Bix Bottom: A Case History' by Vera Paul. This interesting guide mentions the highly successful public appeal for £23,000 to buy the reserve, but of course, with the author's modesty, omits any mention of the spectacular work done to achieve this, work for which she was awarded the O.B.E. The book ends with an appendix on museums with natural history collections, a gazetteer of principal wildlife sites and a bibliography (divided for each chapter).

I would have liked lists of species found in the area covered, but this would perhaps have made the book too long. H. J. M. Bowen's Flora is out of print and not really readily available, as mentioned, and I fear the Floras of Buckinghamshire and Oxfordshire are some years off publication. Checklists would surely help the recording of the flora.

The book is very well illustrated, very readable and well-produced, and at £4·95 very good value for over 200 pages!

S. L. JURY

Essential oils and aromatic plants. A. Baerheim Svendsen & J. J. Scheffer. Pp. 246 with numerous illustrations and diagrams. Martin Nijhoff, Dortrecht. 1985. Price £24·95 (ISBN 90–247–3195–X).

This book represents the Proceedings of the 15th International Symposium on Essential Oils, held in July 1984 in the Netherlands. Like a previous volume reviewed by me (*Watsonia*, **14**: 440 (1983)) its contributions reflect the growing importance of essential oils and aromatic plant ingredients for science, industry and, above all, medicine. Again the potential buyer must be warned that this is not 'a book' but an assembly of loosely connected lecture-papers of a highly specialized nature (in some cases perhaps the sort of paper written by people hastily in order to justify their attendance at a conference!). Maybe only the last contribution of this compilation is of interest to a general reader, namely an essay on medicinal plants mirrored in paintings from the Netherlands (in German, nota bene).

E. Launert

The correspondence of Charles Darwin, Vol. 1, 1821–1836. Edited by F. Burkhardt & S. Smith. Pp. 702. Cambridge University Press, Cambridge. 1985. Price £30·00 (ISBN 0–521–25587–2).

These letters, written by and to Charles Darwin, encompass 15 years of his life, from the time when he was a twelve-year-old schoolboy at Shrewsbury to the period immediately after his return from the famous five-year voyage aboard *Beagle*. The relative amounts of correspondence in the various phases of this period are reflected in the number of pages each phase occupies – Shrewsbury School (18 pp.), medical student at Edinburgh University (22 pp.), undergraduate at Cambridge (136 pp.), naturalist aboard *Beagle* (318 pp.), traveller returned to England (31 pp.). Five appendices, occupying 34 pages, provide a 'Chronology' from his Journal for the years 1809–1836, notes on his *Beagle* records, lists of the 'Persons on board the *Beagle*, 1831–6', books available aboard *Beagle* (a mouth-watering treasurehouse to the bibliophile!) and early notes on coral reefs. Sixteen pages detail alterations to the manuscript letters, the bibliography occupies a further 18 pages, a biographical register and index to correspondents is covered in 50 pages, while a comprehensive index (39 pp.) completes the volume.

The bald outline of this book, just given, provides little indication of the wealth of its contents. Nor can any review. Whilst reading it, I identified with the young schoolboy collecting rocks, plants and animals, surely the experience of most readers of *Watsonia*. I shared the excitement of the undergraduate trying to understand the diversity on this planet and the wonder of a young scientist exposed to the manifold experience and observations provided during a long voyage to foreign parts. Looking back over the years we see Darwin as a Great Man, but these letters reveal him as a very human person as well. To be sure, there are numerous indications of his powers of observation and spirit of scientific inquiry, mirrored by the sound advice and information offered him by many of his correspondents. There is also, however, much in his letters of these 15 years which reflects the understandable concerns of a young man away from his home and, later, country. The Victorian formality of the letters cannot disguise Darwin's easy relations with his family and friends, and their support and affection for him.

This is a strikingly well edited book. The full and helpful footnotes, the clear documentation and the useful appendices all underpin a most scholarly work. The printing is of high quality and largely free from errors. The correspondence is a treasurehouse of the scientific views of Darwin and his friends, of insights into the social scene in which he and they were involved, and of observations on new lands seen through the fresh eyes of youth. Whilst enjoying it one is tempted to reflect on what is being lost by current use of the telephone rather than the letter.

D. M. Moore

The Oxford illustrated encyclopedia. 2. The natural world. Edited by M. Coe. Pp. vi + 375, with numerous colour and black & white photographs and diagrams. Oxford University Press, Oxford. 1985. Price £15·95 (ISBN 0–19–869134–3).

The natural world forms the second part of an eight-volume encyclopaedia, spanning the arts, the social, biological and pure sciences and claiming overall to give a map of contemporary knowledge. It is clearly intended for the layman for it is arranged alphabetically under vernacular names, with Latin or jargon terms kept to a minimum. The subjects are dealt with briefly, few meriting more than three hundred words, but there is an extensive cross referencing. Thus although rats and mice both have their own entry, both of these refer back to more general information under the heading of rodents. Most pages are illustrated with a good proportion of attractive colour photographs.

Overall, however, the book gives the feel of having been assembled by people less interested in the natural world for its own sake than as a background for man. Few of the entries on plants fail to include details of their food, medicinal or pest value, sometimes to the exclusion of other more purely botanical information, while the pest aspect of many animals is stressed to the detriment of other possible detail. One might perhaps have expected this when looking at the plan for the eight volumes, five of which are directly concerned with human evolution, present day societies and achievements. In line with this we find a substantial number of entries are potted biographies of scientists or medical men. Useful, perhaps, but more questionable in a book entitled *The natural world* is to give space to ailments described from a purely human standpoint. Even if other animals do not suffer from club foot, cleft palate or piles, these entries might have been justified with a note to that effect. Acupuncture and homeopathy find places, veterinary medicine and vivisection do not.

Perhaps related to this anthropocentric approach there seems to be some carelessness in dealing with other organisms. The front endpaper refers to reptiles as the first animals to breed on land, in spite of previous remarks about the emergence of invertebrates from the seas. The back endpaper shows an abbreviated scheme of plant, animal and protist classification that includes bacteria, but not blue-green algae, with cryptogams. Opinions may differ on this, but surely both should be together in whatever grouping is decided on. In the main body of the book occasional spelling mistakes – *Hysterimorpha* for *Hystricomorpha*, for example – and misinterpretations of references read mar some entries. The largest octopuses, for instance, have an arm *span*, not arm *length*, of up to 5m. Altogether, in spite of the bright promise of the cover, preface and pictures, this is a disappointing book.

J. Pope

Hardy Geraniums. P. F. Yeo. Pp. 192 with 44 colour plates and 121 figures (line and silhouette). Croom Helm Ltd, London and Canberra. 1985. Price £25·00 (ISBN 0–7099–2907–2).

In this attractive book Peter Yeo has succeeded in combining botanical scholarship with accessibility to the uninitiated (though keen) gardener or naturalist. It is true,as he says, that it is "mainly about identification", but it also contains a clear exposition of the current state of his work on the classification of the genus *Geranium* as a whole.

The title indicates that it is about 'Cranesbills', not tender 'Pot Geraniums' (*Pelargonium*), while the contents show that the author has a very thorough familiarity with the genus in cultivation in all its aspects. Not only has he grown the majority of species and hybrids hardy in the British Isles, but he and Dr H. Kiefer have carried out numerous crossing experiments. The result is an authoritative account of *Geranium* in which personal horticultural experience is evident on almost every page.

The introductory chapters, especially, include much fascinating data that will be of value to botanists as well as gardeners. The chapters on 'Structure and terminology' and 'Structure in relation to function' show in a masterly way the characteristics of *Geranium* and how the variation in each part of the plant is associated with environmental variations (habitat, altitude, pollination, seed dispersal, etc.). The chapter on nomenclature is worth reading by itself as a clear, untechnical exposition of the essentials of the International Code of Botanical Nomenclature, illustrated with examples from *Geranium*. In addition to a well constructed dichotomous key to species and hybrids, there is a multi-access key that is easy to use and should allow one to identify specimens in which all the characters necessary for using the main key are not present.

In Peter Yeo's new classification of *Geranium*, the genus is divided into three subgenera, depending on the method of discharge of the seed. By far the majority of the species fall into subgenus *Geranium* section *Geranium*, one of three sections of that subgenus. The author explains that he has not subdivided this unwieldy section into formal categories because, as yet, he is unable to define the groups that can be recognized. These groups have, however, been given informal names and descriptions. Although only 95 species varieties and cultivars are described in detail (as well as 11 hybrids), these include nearly all the British ones. Only *G. purpureum* is omitted, and it is briefly differentiated from *G. robertianum*.

The illustrations are both excellent and helpful. The author's well known abilities with a camera are demonstrated by the 44 beautiful colour plates, and Frances Hibberd's detailed drawings are excellent. The silhouette or outline of a leaf of each species and hybrid provides a very useful discriminating feature.

In sum, this is a delightful book, taxonomically exact, that will be invaluable for anyone wishing to obtain information about *Geranium* in general, as well as on its cultivation. It is not yet, however, the complete monograph that is badly needed to replace that of Knuth (1912).

N. K. B. Robson

Ouvrages botaniques anciens. Catalogue des ouvrages prélinnéens de la Bibliothèque des Conservatoire et Jardin botaniques de la Ville de Genève. Dressé et publié sous la direction de Hervé M. Burdet. Pp. xxviii + 599, with coloured frontispiece and numerous illustrations in the text. Conservatoire Botanique de Genève. 1985. Price DM 250 (ISBN 2–8277–0105–7).

This lavish catalogue of the 'pre Linnean' books in the library of the Geneva Botanic Garden will prove a delight to every lover of old botanical literature and the student of the history of botanical illustration. It is a handsome, large quarto volume, strongly bound in gold tooled green cloth and finely printed on laid paper as befits a major contribution to the literature of botanical bibliography.

The order of presentation is chronological, but a comprehensive author index enables easy reference to a particular title. The library's holdings of very early herbals is surprisingly poor, with only one incunabula being noted and only 27 entries for works published prior to 1550. In all just over 600 titles are listed. The bibliographical entry for each item is on familiar lines, with a transcription of the title page, note of the imprint, pagination and register of signatures. Some minor errors in the title transcriptions have been noted; for instance entries number 213 and 473 both transcribe colons which are not in fact present on the title page, and pagination details under entries 390 and 448 appear to be slightly awry. Whilst such minor imperfections may cause irritation when using the catalogue to compare and collate another copy of a particular volume, they do not significantly detract from a work which does contain some detailed collations not easily obtainable from other printed sources. It is a pity however that the opportunity was not taken to give details of the provenance of important individual items and to include details of any unusual features. For example the coloured frontispiece is a reproduction of a page from what appears to be a contemporary coloured copy of Brunfel's herbal of 1539, yet no mention is made in the catalogue entry of what is surely an important attribute of this particular copy.

A principle attraction of the catalogue is in the generous number of really fine illustrations; the great majority of entries are accompanied by a facsimile reproduction of a significant text page, title page or portrait of the author, and it is this feature that gives so much pleasure and enables one to browse with continual enjoyment through what could have so easily been a 'dry as dust' production. The choice of illustrations is excellent, mirroring the art of botanical illustration over a period of some 250 years, with a leavening of maps, butterflies, mammals, etc. (plus the odd 'indelicate' woodcut) to break the monotony which is sometimes inherent in works of this kind. Either the library is fortunate enough to possess exceptionally 'clean' copies of the books described or the illustrations have been very skilfully prepared, for nowhere is there much evidence of unsightly library stamps or paper imperfections which so often mar reproduced illustrations of this kind.

It is to be hoped that this publication will receive sufficient support to encourage the publication of a 'post-Linnean' volume in the not too distant future.

M. Walpole

Mr. Marshal's Flower Album from The Royal Library at Windsor Castle. Introduction and commentary by John Fisher, Preface by Jane Roberts. Pp. 128, including 36 coloured plates. Victor Gollancz, London. 1985. Price £20·00 (ISBN 0–575–03536–6).

The mid-seventeenth century Florilegium of Alexander Marshall is now in the Royal Collection at Windsor Castle. It is of particular interest as Marshall was renowned as one of the earliest water-colourists and he spent a good deal of time and ingenuity in deriving pigments from various plant and vegetable sources to provide a unique freshness to his coloured drawings. How well he succeeded it is not possible to judge from this album of reproductions for, despite the use of modern colour printing techniques, one is left with a feeling of lack of authenticity.

Thirty plates (from a total of 164) are reproduced, all with a distinct charm and each portraying several species of plant (many being novelties of the time); and although the general impression is of an artist with considerable botanical skill, the reproductions are such that it is really impossible to assess the fine detail which was the hallmark of so many of the fine botanical drawings of this period. Certainly the unique vibrancy of colour Marshall is said to have created is not apparent. I am left with the distinct impression that justice has not been done to the originals and the hope that the opportunity of seeing the original work might sometime be possible.

To supply suitable text for a rather random selection of drawings presents a challenge to any writer. John Fisher has chosen to quote quite liberally from the old herbal writers, Gerard, Culpeper, Turner and the like, but also weaves into his writing an additional mixture of folklore and nomenclature plus the odd note of taxonomic and historical interest which results in very readable and at times entertaining narratives. The scholarly preface by Jane Roberts pieces together some details of the 17th century background of Marshall's work and is a valuable contribution to a publication which brings to our attention a unique item of early English botanical literature.

M. Walpole

God's Acre: the flowers and animals of the parish churchyard. F. Greenoak. Pp. 192, with numerous black & white and water-colour illustrations. Orbis Publishing Ltd, London. 1985. Price £12·95 (ISBN 0–85613–800–2).

By the time this review is printed, I feel confident that this beautiful book will be familiar to most naturalists and possessed by many. On almost every page, Clare Roberts' delightful illustrations grace the text; it is indeed the perfect 'coffee-table book'. It is also a particularly timely publication, for all over the country there are groups of people who quietly lavish care upon our 20,000 churchyards, and treasure them as oases of peace and beauty in an increasingly harsh and strident world. To these faithful servants – and to the very many others who appreciate their devotion – this book is especially aimed.

The care of churchyards is a complicated subject which until recently was hardly ever the concern of naturalists – unless, of course, they were also the incumbents, and even then the natural history of the churchyard was often taken for granted. In this self-conscious age, however, it is no longer possible for us to enjoy nature without realizing how fragile are the wild plant and animal communities our ancestors took for granted. So, in the last decade, even churchyards have come under a new scrutiny. Francesca Greenoak's book is designed to do two things: to open the eyes of ordinary readers to the wealth of interest in the wild life of the churchyard, and to convert those who already enjoy the serenity and beauty of particular churchyards to a middle way of management when, as so often is the case, the local community has to decide how the churchyard must be cared for. In the first of these aims this book will surely succeed. In the second aim, however, I must confess to a slight sense of disappointment for, though the author herself clearly appreciates the principles of ecological management, the book presents no very clear practical guidance to the enthusiastic naturalist who may wish to help in the conservation of his or her favourite churchyard. Should these practical guidelines not have appeared as another Appendix, along with the (very valuable) Appendices devoted to relevant literature and organizations? I have in mind a condensed form of Arthur Chater's excellent paper in the Church of England periodical

Churchscape (vol. 3, 1984, pp. 21–7) entitled 'God's Acre: the conservation of consecrated vegetation', which gives clear advice on, for example, ivy control, the use of 'strimmers' for cutting rank grass, and the control of Manpower Services Commission working parties!

The title of this book is oddly misleading in one important respect. Francesca Greenoak is too good a botanist to restrict her text to 'flowers', or even to the Flowering Plants. Indeed, she is clearly a convert to the study of lichens, as pages 87–92 amply demonstrate, and the trees of churchyards also find their place in the book. But what, incidentally, has happened to the bryophytes? Some of the most remarkable rarities of churchyard tombs are mosses, and the specialist ecology of moss communities on gravestones is full of interest for the naturalist. If the index is correct, mosses receive mention or illustration on only four pages, and not one of the three illustrated species is said to be drawn in a churchyard.

On churchyard animals, the book ranges widely, though inevitably the birds and insects get the lion's share of publicity. (Incidentally the list of the '20 commonest churchyard birds' supplied as Appendix V by the British Trust for Ornithology, is surprisingly accurate for my own local churchyard, and I can imagine many readers happily making their own comparisons.) The newcomers to the naturalist's 'quarry' are the bats, and churchyards are, of course, especially interesting as habitats to be studied. 'Call in your local Bat Group' is Francesca Greenoak's advice – advice which I can strongly recommend from personal experience.

Minor errors seem to be commendably few, though many B.S.B.I. members' eyebrows may be raised when they read (p. 125): 'the true Date Palm of the Holy Land grows in Britain . . .' and 'has been planted in a number of churchyards' in the south-west! (Is this the familiar confusion between *Phoenix* and *Cordyline*?). The index has passed a small random test reasonably well, though the important churchyard fern genus *Asplenium*, mentioned at least three times in the text, seems to have slipped through the net.

In her 'Author's Note and Acknowledgements', Francesca Greenoak explains how much of the idea for the book stemmed from a survey, organized by Sue Parish and conducted by Women's Institutes, of 1400 churchyards in England and Wales, and acknowledges her indebtedness also to several specialist societies, amongst them the B.S.B.I., who have conducted churchyard surveys in recent years. Among the many people whose help is acknowledged individually I was pleased to see Mary Briggs, Arthur Chater and Frank Perring. The preparation of the book was much affected by the death in 1983 of John Talbot White – there is a very apposite quotation from his writings given pride of place in the beginning of the first chapter on 'History and Heritage' – and Francesca Greenoak herself took over only at this late stage. We all owe her a great debt for so attractively marrying together much separate advice, and wish the book all the success it so richly deserves.

S. M. WALTERS

Insects and flowers, the biology of a partnership. Friedrich G. Barth (translated from the German by M. A. Biedermann-Thorson). Pp. ix + 279, with 37 plates, many in colour, and 97 text-figures. George Allen & Unwin, London & Sydney. 1985. Price £30·00 (ISBN 0–04–574029–1).

The time has passed when it was possible to deal reasonably adequately with all the aspects of pollination biology in one book. Now one has to consult several, and they vary in their assumptions about the reader's background. This one assumes little and is written in everyday language. It puts our knowledge of insect-pollination into a wide historical framework, relating the facts where possible both to everyday life and to scientific theory of the past and present. The author is an entomological neuro-physiologist, and his main concern is to tell us about the structure, sensory equipment, sensory perception and behaviour of insects as they relate to pollination. In doing so, he has accomplished an outstanding piece of popularization, carrying us to at least a basic level of understanding in a long series of complex enquiries (but I make exception to the last two sections of Chapter 25). All of it is fascinating, and much of it astounding. At the beginning, the life-history of vascular plants and the main types of flower, their various attributes and the means by which they secure the services of insects in pollination are briefly outlined in chapters that are interspersed with others about insects, but in the later part of the book the insects take over entirely.

While the book is accessible to the layman it will be of value to students, and if it is not deep enough for them the extensive bibliography will take them further. The book is excellently and generously illustrated with line-drawings, well-chosen colour photographs and scanning electron micrographs. (The picture of a bee-fly on a bugle flower on plate 11 has apparently been rotated anti-clockwise through a right angle.)

Two points on which explanation is inadequate seem worth mentioning. On p. 115 the colour-change in the guide-marks on the flower of *Aesculus*, which occurs when nectar-production ceases, is discussed, and it is mentioned that flowers of most species simply wither at this stage. The point not made is that the distant signal of the large many-flowered inflorescence can remain unimpaired if the pollinated flowers remain fresh. On pp. 179–180 it is stated that, of the perfumes that are collected by certain tropical American bees, two compounds are specially attractive, and then that "the attractiveness of an odor component may be diminished when a second component is added to it". The point is that the number of *species* of bee attracted is diminished; the mix of compounds actually found in the orchids varies from one species to another, and the different 'perfumes' resulting attract bee species selectively, "thereby" as the author says "increasing the specificity of pollination".

The German edition of this book was published in 1982; it is now almost faultlessly translated and reads very well (but *Pteridium aquilinum* gets the English name 'eagle fern'; 'palm ferns' (p. 259) are presumably cycads). However, in the bibliography, English editions of other translated works ought to have been cited instead of the originals, and the list of books on pollination ecology for Chapter 3 should have been up-dated (most of the missing titles will be found under 'Further Reading' in *The sex life of flowers* by Meeuse & Morris (1984), reviewed *Watsonia* **15**: 416). Book production is good but there are two irritating faults: (1) when plates are mentioned in the text there is no page reference; (2) the chapter number should have been included in the running heads to facilitate reference to the bibliography which is at the end of the book and divided into chapters.

P. F. YEO

Obituaries

JOHN PATRICK MICKLETHWAIT BRENAN
(1917—1985)

With the death of Pat Brenan in London on 26th September 1985 the world of botany lost one of its giants. This, however, is not the place to dwell upon his numerous and important contributions to African floristics or his administrative accomplishments at Kew, but rather to review his work and achievements in the study of the flora of our islands.

Born at Chiselhurst, Kent, on 19th June 1917, the younger son of Dr A. R. M. Brenan and his wife Jill, Pat was attracted to the study of plants from early childhood, an interest encouraged by his father and brother, both of whom were knowledgeable on British wild flowers. He received his early education at Tonbridge, and it was from here in 1933 that he joined the B.S.B.I. (then the Botanical Society and Exchange Club of the British Isles). This was a period of great transition in the Society's fortunes, for the autocratic G. C. Druce who had dominated its activities for so many years had died in 1932, and a wind of change was blowing. The Society's report for 1934 included a spate of Kentish records from the enthusiastic new member, as well as some contributed by his father and brother. A report of *Bupleurum subovatum* (as *B. lancifolium*) as a spontaneous garden weed at Tonbridge indicated the high standard reached by the young botanist, for descriptions of that bird-seed adventive did not then appear in British Floras and such finds were invariably referred to the rare *B. rotundifolium*; furthermore, records of several *Chenopodium* species hinted at an awakening interest in a critical genus on which he was to be eventually acknowledged an international authority.

In the summer of 1935 Pat made contact with the skilled alien plant specialist Mrs C. I. Sandwith, and together they visited Avonmouth Dock and other important exotic plant sites in the Bristol area; later in the year they extended their forays to similar habitats at Barry and Cardiff Docks. During this year too he paid one of his early visits to the Royal Botanic Gardens, Kew, little anticipating that some 40 years later he would become its Director. Attention was also given to interesting adventives growing by the Thames between Kew and Mortlake where, with his maternal uncle, R. N. Parker, a botanist who had spent much of his life in the Indian Forestry Service, he saw *Ailanthus altissima*, *Ficus carica* and *Vitis vinifera*. Late summer and early autumn days were spent in visits to those happy hunting grounds for the alien plant enthusiast, the famous Dagenham waste in Essex and the vast metropolitan rubbish-tips at Yiewsley, Middlesex and Iver, Bucks. In 1936 he won a scholarship to the University of Oxford, and proceeded to Brasenose College, where it had been his intention to read modern languages; a growing love of plants, a natural inclination to taxonomy and influence by his brother persuaded him, however, to change to natural sciences. Work now filled most of his waking hours, but such leisure time that was available was spent in the field in the rural countryside of Oxfordshire and Berkshire, often in the company of John Chapple who had liased closely with Druce, and who was at this time Honorary Secretary of the B.E.C., P. G. Beak, the *Populus* specialist, R. Burn and N. E. G. Cruttwell. During the long vacation further visits were made to Bristol and Cardiff with Mrs Sandwith and her son Noel, who became one of Pat's closest friends, an association which lasted until the sudden and untimely death of Sandwith in 1965. Never was there a more knowledgeable partnership on British plants than these two; a day in the field with them was both a privilege and awe-inspiring, and one returned home realizing sadly how little one knew of the British flora. It was in 1936 also, in the company of Ted Lousley, that *Carex montana* was refound between Tunbridge Wells and Eridge, E. Sussex, in a locality where it had first been noted as British by William Mitten in 1845; later he and Pat saw *Bromus interruptus* growing in a field of Sainfoin at Upper Halling, W. Kent.

Alien studies with the Sandwiths at Bristol and Cardiff were resumed in the summer and autumn of 1937, and a search for brewery malting adventives was undertaken at Burton-on-Trent, Staffs. in the company of John Chapple. During term time field work continued in the upper Thames Valley.

In August 1938 and again in 1939 Pat toured Ireland with N. Douglas Simpson, making many new and important plant finds. In 1939 too, while staying with Simpson at his Bournemouth home, a joint foray to Poole Harbour, Dorset resulted in the discovery of *Carex* × *tornabenii* (*C. distans* × *extensa*), a hybrid new to the British flora.

During 1940 Pat graduated with first class honours in botany and accepted a post at the Imperial Forestry Institute, Oxford. By the end of his student days he had compiled a personal herbarium of over 5000 British and Irish specimens, with an emphasis on critical material, but he showed little regard for the Exchange Club activities of the Society, contributing but a few sheets of a single gathering of *Senecio squalidus* × *vulgaris* collected near Oxford in 1946 by himself and John Chapple.

His duties at the Imperial Forestry Institute consisted of teaching and research, and saw the beginning of his African studies; and, although work occupied much of his time, some leisure hours were still allocated to investigating the Oxfordshire and Berkshire flora, sometimes with F. B. Hora, the mycologist, and J. N. Mills, who later specialized in *Hieracium*. In March 1945 he was elected to the B.E.C. Committee (now Council) and to the Excursions and Field-work sub-committee (now Meetings Committee), on which he served for a number of years; he also organized and led a field meeting in the vicinity of Oxford. The results of his extensive field work in Oxfordshire and Berkshire were brought together in a long paper in the *Report of the Botanical Society & Exchange Club* for 1943–44; and in the same periodical appeared a joint account with J. E. Lousley on floral variations in *Stellaria holostea*.

The year 1947 was an eventful one: Pat joined Peter Greenway and Ronald Keay on a plant collecting expedition to Northern Rhodesia (Zambia) and Tanganyika (Tanzania), and shortly after his return to England again visited Africa with the Cambridge University Botanical Expedition to Nigeria and the Cameroons under the leadership of Paul Richards. Despite this increased activity, British botany was not forgotten; he briefly became B.S.B.I. Local Secretary for Oxfordshire, v.c. 23, and joined the Society's panel of specialists as the referee for *Amaranthus* and *Chenopodium*, a function that he maintained to the end. His continued interest in alien plants was confirmed by the publication of a paper entitled "A contribution to the adventive flora of Southampton".

Pat's reputation as an extremely competent taxonomist with an increasing knowledge of African plants both in the field and the herbarium was now established, and in 1948 he transferred to the Tropical African Section of the herbarium, Royal Botanic Gardens, Kew, as Senior Scientific Officer, to work on the new *Flora of Tropical East Africa*. Notwithstanding a growing work load, time was found to pen a few short notes on British plants. In April 1949 he was elected to the B.S.B.I. Council, on which he served for three years; and in collaboration with John Chapple he produced an account of the Australian *Myriophyllum verrucosum* in Britain, and followed it with one of his most important papers, involving much detailed and careful research, "*Artemisia verlotorum* Lamotte and its occurrence in Britain". During this period he was still expanding his alien studies – visiting the 'shoddy' fields of Bedfordshire for wool adventives and the soya bean site near Harefield, Middlesex, for the wide range of N. American ephemerals.

In 1950 Pat married Jean Helen Edwardes and settled down to family life at his Kew home. He was elected a Fellow of the Linnean Society of London in 1952 and in the following year joined the B.S.B.I. Publications Committee where, apart from a few short breaks, he was a prominent figure almost to the time of his death. His family and his work on African plants now filled his time as he steadily built on his reputation as one of the world's leading taxonomists with a special interest in the families Leguminosae, Chenopodiaceae and Commelinaceae. During 1959 he became head of the Tropical African Section of Kew Herbarium, and in 1961 produced his major paper on British botany – a revision of the critical genus *Amaranthus* in these islands. Three years later he wrote the account of *Chenopodium* for the first volume of *Flora Europaea*.

On the retirement of Dr C. E. Hubbard in 1965, Pat was a natural successor to the post of Deputy Director and Keeper of the Herbarium and Library at Kew, and was urged, somewhat against his will, to apply for the position (successfully). The move to an administrative situation at the zenith of his scientific life doubtless imposed a burden on him, but he overcame it, and with renewed vigour became Botanical Secretary of the Linnean Society from 1965 to 1972, President of the Association of Tropical Biology (1970–1971) and President of the Kew Guild (1972–1973). With the early and unexpected resignation of Professor J. Heslop-Harrison from the Directorship of the Gardens in 1976, Pat was again the obvious, if somewhat reluctant, candidate to follow him, which he did. In 1977 he was appointed a Visiting Professor to the University of Reading, and in 1978 was honoured by Portuguese botanists in being elected an Honorary Member of the Sociedade Broteriana; he also received the highly coveted Victoria Medal of Honour from the Royal Horticultural Society. To his many advisory posts he added that of Honorary Botanical Adviser to the Commonwealth War Graves Commission, serving until 1982. In 1979 he was given one of the Willdenow commemorative medals struck by the Berlin Botanic Garden, and in May 1981 he was elected President of our Society; he also became Director of the International Council for the Development of Under-utilized Plants.

October 1981 saw Pat's retirement from the Directorship of Kew, and in the months that followed he travelled abroad with his wife, renewing old friendships and visiting S. Africa, Australia and Hawaii. While in S. Africa in February 1982 he was one of three botanists awarded a special medal issued by the South African Association of Botanists. On his return to England he joined the Council of the National Trust.

Botanical interests were pursued almost to the end, and his large, loose-limbed figure was frequently to be seen in the herbarium and library at Kew, where no matter how busy he was he always found time for a friendly word. Time allotted to various committees was still willingly and freely given, and at the time of his death he was serving over twenty organizations.

Pat Brenan was a brilliant scholar, fluent in several European languages and in Latin; a kindly, modest man who showed great consideration to all; a private individual blessed with a remarkable memory and a great curiosity, while beneath a somewhat serious exterior lurked a fine sense of humour. His botanical life was aptly summed up by Dr Roger Polhill in his address at the memorial service held at St Anne's Church, Kew Green, on 23rd October, in the words – "To Pat all plants were wondrous".

THE BRITISH AND IRISH WRITINGS OF J. P. M. BRENAN

1939

Galinsoga quadriradiata Ruiz & Pav. in Britain. *Rep. botl Soc. Exch. Club Br. Isl.* **12**: 93–94.

1945

(With Simpson, N. D.) A hybrid sedge new to Britain. *N. West Nat.* **20**: 202–206. [*Carex distans* × *extensa* = *C.* × *torbenii* Chiov.]

1946

(With Mills, J. N.) 308/5. *Scabiosa arvensis* L. *Rep. botl Soc. Exch. Club Br. Isl.* **12**: 679–680. [Note on aberrant form].

396/4 × 2. × *Cirsium sabaudum* Löhr (*C. acaule* × *vulgare* = *lanceolatum*). *Rep. botl Soc. Exch. Club Br. Isl.* **12**: 682–683.

641/1. *Myrica gale* L. *Rep. botl Soc. Exch. Club Br. Isl.* **12**: 686–687. [Note on monoecious bushes with androgynous catkins].

Notes on the flora of Oxfordshire and Berkshire. *Rep. botl Soc. Exch. Club Br. Isl.* **12**: 781–802.

(With Lousley, J. E.) Floral variations in *Stellaria holostea* L. *Rep. botl Soc. Exch. Club Br. Isl.* **12**: 840– 846.

1947

354/2b. *Galinsoga quadriradiata* Ruiz & Pav. var. *hispida* (DC.) Thell. *Rep. botl Soc. Exch. Club Br. Isl.* **13**: 30.

A contribution to the adventive flora of Southampton. *Rep. botl Soc. Exch. Club Br. Isl.* **13**: 106–112.

1948

196/11. *Crataegus monogyna* Jacq. var. *xanthocarpa* Lange. *Rep. botl Soc. Exch. Club Br. Isl.* **13**: 260–262.

†435/13. *Campanula alliariifolia* ("*alliariaefolia*") Willd. *Rep. botl Soc. Exch. Club Br. Isl.* **13**: 263–265.

†596/26(2). *Amaranthus blitoides* S. Wats. *Rep. botl Soc. Exch. Club Br. Isl.* **13**: 269–271.

†600/26(2). *Chenopodium pumilio* R. Br. *Rep. botl Soc. Exch. Club Br. Isl.* **13**: 272–273.

Senecio squalidus × *vulgaris* L. *Rep. botl Soc. Exch. Club Br. Isl.* **13**: 364.

1949

(With Chapple, J. F. G.) The Australian *Myriophyllum verrucosum* Lindley in Britain. *Watsonia* **1**: 63–70.

(With Simpson, N. D.) The results of two botanical journeys in Ireland in 1938–9. *Proc. R. Ir. Acad.* **52B**: 57–84.

1950

Artemisia verlotorum Lamotte and its occurrence in Britain. *Watsonia* **1**: 209–223.

1952

Allen, G. O. *British Stoneworts (Charophyta)*. *Watsonia* **2**: 213. [Review]

1953

†206/13. *Galium parisiense* L. *Watsonia* **2**: 413.

1956

Notes on the flora of Oxfordshire and Berkshire: 2. *Proc. bot. Soc. Br. Isl.* **2**: 105–114.

1961

Amaranthus in Britain. *Watsonia* **4**: 261–280.

1964

Chenopodium, in Tutin, T. G., *et al.*, eds. *Fl. Europaea* **1**: 92–95. Cambridge.

1966

Noel Yvri Sandwith 1901–1965. *Taxon* **15**: 254–255. [Obituary]

1967

Obituary: Noel Yvri Sandwith (1901–1965). *Proc. bot. Soc. Br. Isl.* **6**: 418–422.

1968

The relevance of the national herbaria to modern taxonomic research, in Heywood, V. H., ed. *Modern Methods in Plant Taxonomy*, pp. 23–32. London.

1971

The role of the herbarium in the work of Kew. *J. Kew Guild* **8**: 1127–1134.

1972

Profile. Professor John Heslop-Harrison. *B.S.B.I. News* **1**(2): 30–31.

Edgar Milne-Redhead. *Kew Bull.* **26**: 1–3.

1973

The value of herbaria for cultivated plants, in Green, P. S., ed. *Plants wild and cultivated*, pp. 38–47. London.

1975

Mr V. S. Summerhayes. *The Times*, 7th January 1975. [Obituary]

Obituary: Victor Summerhayes. *Bull. Brit. Ecol. Soc.* **6**(2): 5–6.

1976

Godwin, H. *History of the British flora – A factual basis for phytogeography*, 2nd ed. *Kew Bull.* **31**: 411–412. [Review]

1980

Obituary: Edward James Salisbury (1886–1978). *Watsonia* **13**: 68–70.

1981

President's message. *B.S.B.I. News* **2(28)**: 3.

1983

Presidential address, 1982. The British flora – A changing picture. *Watsonia*, **14**: 237–242.

D. H. Kent

URSULA KATHERINE DUNCAN
(1910—1984)

Ursula Duncan M.A. LL.D., F.L.S., L.R.A.M. was born in Kensington, London in 1910, the elder daughter of the late Commander J. A. Duncan and his wife, the former Dorothy Weston. During her infancy, the Duncan family, whose origins in Angus can be traced back to 1705, returned to Parkhill, Arbroath, their ancestral home since 1799. Dr Duncan's childhood education was entrusted to a governess, Miss Isobel Leslie, and under her tutelage she passed the Entrance School Certificate to Cambridge at the age of 15, obtaining a distinction in Greek. Of studious and intellectual bent, Dr Duncan registered as an external student of London University, obtaining a BA in 1952 and a MA in 1956 in classics, a period during which she also visited Greece. She also became a pianist of some distinction, excelling in musical theory and professing a preference for Bach and Mozart; she became a Licentiate of the Royal Academy of Music in 1948.

During the Second World War she served for a time in the Censorship Department, based on Inverness, dealing with the censorship of forces mail, an experience which she confided "brought her face to face for the first time with harsher realities of personal life" and from which she derived an understanding and experience of people which she valued in later life. The death of her father in 1943 curtailed her work in Inverness, and she returned to Parkhill to take over the supervision of the family estate including 600 acres of farmland, an undertaking which she proceeded to carry out with financial astuteness, foresight and considerable success for the rest of her life.

Her interest in botany commenced at the age of ten, and she was much encouraged in the pursuit by her father after his retirement from the Royal Navy at the end of the First World War. What was destined to be her major recreation throughout life started with vascular plants and extended in 1939 to the bryophytes as well as the lichens.

She was a member of the Wild Flower Society from her youth and joined the Botanical Society and Exchange Club of the British Isles in 1931, becoming the recorder for Easter Ross and serving on the Committee for the study of the Scottish Flora for many years. As with her studies of cryptogams she delighted in those genera which presented a taxonomic challege, such as *Potamogeton*, *Hieracium* and *Taraxacum*; she always considered the grasses as the most intractable and she became a considerable expert in this group. With these 'little difficulties' she kept up a life-long correspondence with a wide range of specialists who, in turn, benefitted greatly from her many new records, collections and valuable field data, mostly from botanically under-explored areas of Scotland. Her personal generosity and kindness to her botanical friends, young or old, amateur or professional, became one of the hallmarks of her considerable botanical flair and her great success as a field botanist.

The publication of the *Flora of East Ross-shire* in 1980 marked the successful culmination of many years of intrepid and tireless tramping to all areas of the vice-county, often alone, in inhospitable terrain, and in all types of weather, always, characteristically, in wellington boots! She also had a particular interest in the floras of Angus and the Island of Mull; indeed her preliminary studies on the vegetation of Mull were largely instrumental in the initiation of the Flora of Mull Project carried out by the Botany Department, British Museum (Natural History), to which she subsequently gave generous and wholehearted support.

She was introduced to lichenology by Mr R. H. Brown of Oxford and Dr W. Watson of Taunton and soon became one of the select few who kept lichenology alive during the period of its greatest decline in Britain between 1945 and 1955. Even more importantly, by unstintingly putting her time, knowledge and collections at the service of young aspiring lichenologists she undoubtedly played a premier rôle in the renaissance of the subject in Britain. Of her three books on lichens, the last, *An Introduction to British Lichens*, published in 1970, reflects the resurgence of interest in the group and the major part she played in its revival. She was a founder member of the British Lichen Society. As with other groups of plants, she contributed records continually to mapping schemes and census catalogues, providing, for instance, over 25 per cent of the Scottish records in W. Watson's *Census Catalogue of British Lichens* (1954).

Her early studies on mosses and hepatics were with her namesake Mr J. B. Duncan, and she soon became an active member of the British Bryological Society. It was characteristic that her interest turned in particular to the challenge offered by the Sphagnales, for which she acted as a referee and published an illustrated key. As with vascular plants and lichens, she also acted as a referee for beginners, ecology students, mapping recorders, etc., attending to their many letters and specimens with prompt and meticulous thoroughness.

She eschewed formal representation on committees and was happiest when in the field, either gently and patiently encouraging 'her beginners in smalls and greens' or, with botanical friends, amateur or professional, exchanging specimens and expertise, or leading one of the many field meetings to various parts of the British Isles. She had a rare intuitive flair which made her an outstanding field botanist, in addition to being a naturally gifted teacher with an instinctive ability for conveying her enthusiasm and knowledge whatever the level of experience of the recipient. Reticent about her many achievements and naturally modest by nature, she never sought the limelight and was most content in the surroundings of her own home. Friends who visited her were always welcome and were able to share with her her enthusiasm for gardening, particularly her interest in vegetable growing, rhododendrons, *Meconopsis*, *Cardiocrinum* and, in the quarry which furnished the building stone for Parkhill, a fine range of *Primula* species.

She amassed a large and important herbarium of vascular plants, rich in carefully collected material of critical and difficult taxa and much of it identified or checked by specialists; she donated this to Dundee Museum in 1983. Failing eyesight and ill-health caused her to give her cryptogams to the herbarium of the Royal Botanic Garden, Edinburgh later in that year.

Dr Duncan was honoured by the Linnean Society with the Bloomer Medal, by the British Lichen Society with an honorary membership and, in 1969, by the University of Dundee with the Honorary Degree of Doctor of Laws, public recognition and expressions of gratitude for her private generosity and kindness to all whom she helped and who shared her enthusiasm for plants and their habitats, as well as recognition of her unique contribution to British Botany.

P. W. James

Reports

CONFERENCE REPORT

RECORDING CRITICAL GROUPS IN THE FLORA OF THE BRITISH ISLES, LIVERPOOL, 13th–14th SEPTEMBER 1985

INTRODUCTION

A total of 98 members of the B.S.B.I. and the Biology Curators' Group attended this meeting based at the Merseyside County Museums and the University of Liverpool. A feature of the conference was the workshop sessions where small groups were guided through the difficulties of identification in critical groups by session leaders, each of whom was particularly knowledgeable in his or her field. To help these sessions, the Museum's herbarium was available and a block of four rooms enabled simultaneous sessions to be held, yet with the flexibility for members to change from one session to another as they wished. Most of the sessions were held at the County Museums but other venues included the Department of Botany at the University of Liverpool (Computer Workshop) and the Halls of Residence of the University of Liverpool (Recorders' Forum), whilst a Reception by the Merseyside County Council and an evening talk on 'Operation Groundwork' were held at the Merseyside Maritime Museum.

The Society is greatly indebted to all those who helped to make the conference a success, and is especially grateful to the generosity of the speakers and workshop leaders who helped to keep the costs of the conference to affordable levels.

E. F. Greenwood & J. R. Edmondson

ABSTRACTS OF PAPERS

LOCAL FLORAS: THE CRITICAL ELEMENT

THE CRITICAL ELEMENT – WITH SPECIAL REFERENCE TO THE ISLE OF MAN

The coverage of critical groups is disappointingly meagre in many modern local Floras. Three reasons can be identified: printing costs, the trend towards shorter-term projects, and lack of taxonomic self-sufficiency. That the sheer size of certain groups compels a certain economy of treatment has to be accepted: sacrificing the coverage of critical taxa in the interest of producing a Flora speedily is more open to challenge. Short-term projects have become the norm in those parts of Britain where field botanists are sufficiently numerous to give rise to substantial teams and where habitat alteration is sufficiently rapid and severe to cause Floras to date quickly. The increasingly heavy emphasis in local Flora work since 1948 on dot-distribution mapping has tended to militate against adequate recording of critical taxa, despite the special value of these in indicating regional and sub-regional affinities and the greater need for their existence to be notified for conservation purposes. By undertaking the study of these taxa themselves, instead of delegating the task to a series of specialists, some or all of whom may be unfamiliar with the local environment and with the local flora more generally, Flora writers can provide a more integrated treatment and use their resulting breadth of view to make illuminating comparisons. The size of this task, however, must vary from area to area. The author's experience in the Isle of Man, discussed by way of example, may have been by no means typical in this respect.

D. E. Allen

THE ALIEN FLORA OF GUERNSEY

Ten years ago *Wild Flowers of Guernsey* (1975) put the recorded wild and naturalized plants there at 1340. Since then the total has risen to some 1400. Over half of these are aliens. They come from the four corners of the globe, some are transient, but many have settled down and are a welcome enrichment of the island's tally, only very few endangering native vegetation. Naming new ones calls for familiarity with foreign Floras, consultation of herbaria and a generous amount of help from professional botanists, plantsmen and other specialists. One or two in Guernsey are not yet satisfactorily named through the absence of type specimens or other reliable material. But these newcomers add extra fascination to a fascinating island, not least in pondering when some will become similarly established in England.

D. McClintock

RECORDING IN IRELAND: PROBLEMS AND PRIORITIES

The organization of recording in Ireland was described and discussed, together with remarks on problems encountered in the field. These include the distances recorders must travel from home to their area of study, and problems of species identification. New vice-county recorders' plans were outlined, and reference was made to contributions by visiting botanists.

D. Doogue

B.S.B.I. HANDBOOKS: PROGRESS REPORTS

CRUCIFERAE

The Cruciferae are well represented in Britain and Ireland, with about 300 species recorded to date. They can be considered a critical group because there are a large number of superficially similar species (especially in the 'Yellow Crucifer' aggregate) that cause problems of identification at both the generic and specific level. The genera, despite forming natural groups, are especially hard to define clearly. Within a genus, the species are usually easier to distinguish though there are a few critical genera. Many of the characters require careful examination and a combination often has to be used. It is usually necessary to have both mature flowers and ripe fruit. Some characters are more easily observed on fresh rather than herbarium material, and vice versa. The aim of the Cruciferae Handbook is, therefore, to provide an aid to identification of species likely to be found in the British Isles and Ireland. It will follow the general style and format of the other B.S.B.I. Handbooks. Taxonomy and nomenclature will follow *Flora Europaea* but incorporate recent updates. Descriptions are being prepared from live and herbarium material. Distribution maps will be provided for many species by the Biological Records Centre. Ecological, cytological and other general information will be included where relevant. It is hoped the Handbook will be illustrated by amateur artists. It is planned for publication in 1989.

T. C. G. Rich

LEGUMES

A publication on legumes is being prepared for the B.S.B.I. Handbook Series, and information and help is sought from members. The Handbook will differ from its predecessors in a number of ways. For each species the description, which will be comparatively brief, will be accompanied by illustrations and notes on habitat and use. Distribution maps may also be included. Approximately 100 native and well established alien species will be treated in full but thumbnail sketches will be included for many other aliens. The Handbook is anticipated to be of interest to foreign botanists, particularly those from areas in which the weed legume flora includes many of our species.

A variety of identification aids, including multi-access keys are being considered as alternatives to dichotomous keys. Separate chapters will deal with dispersal, legume/insect interactions, pollination biology and pollen and honey sources. An innovative aspect of Handbook production is that, for the tribe Vicieae (approximately one third of the species), morphological and other information will come initially from the Vicieae Database in Southampton.

R. Allkin

WEEDS

Weeds constitute a familiar group of plants that affects the lives of all of us. Many definitions have been proposed for the word 'weed', but most agree that a weed is an opportunist plant that causes problems of one sort or another to agriculture, horticulture and other human industries. Weeds have evolved alongside man and have become adapted to the various niches provided by his activities. In order to be able to control weeds with any degree of efficiency, it is important to be able to identify them correctly and to know at least a little of their biology, notably aspects of their life-history, dispersal and ability to withstand destruction by man. Thus, a handbook that brings together information on this group of plants is now in preparation, as there are surprisingly few authoritative texts on the subject. It should be noted that weeds are intrinsically interesting, and they are perfect material for the study of evolutionary processes – easily grown plants, adapted to a variety of catastrophic habitats! The proposed Handbook is being designed for use principally in arable and garden habitats, and other disturbed communities created and maintained by human activities. Aquatic ecosystems are not to be included (although some species typical of wetter soils will be treated), as this would introduce an unwieldy, extra element into the text. Grasslands, with the exception of lawns, will not be given a full treatment. The systematic section of the book will contain accounts of individual species and, in certain cases, groups of species within a genus. There will be detailed descriptions, notes and ecology, distribution and history of particular species, and any appropriate comments on pharmacology, folklore and more anecdotal material. It is thus hoped to introduce weeds to a wider public.

J. R. Akeroyd

TAXONOMIC WORKSHOPS

A LOCALIZED APPROACH TO THE HAWKWEED PROBLEM

The emphasis of the workshop was to show how aspiring field botanists can gain practical knowledge of the genus. It sought to cover the collection of specimens, the main sources of written information, the major relevant herbaria, and the subdivisions of the genus in Britain.

Examples of the main series/sections were available for study. These were recently determined specimens mostly from southern Scotland and northern England.

D. J. McCosh

VARIATION AND HYBRIDITY IN SOME BRITISH SPECIES OF *ASPLENIUM* AND *POLYSTICHUM*

Characters were given for the separation of (a) *Asplenium adiantum-nigrum*, *A. billotii* and the hybrid *A.* × *sarniense*, and (b) the serpentine and non-serpentine forms of *A. adiantum-nigrum*. A range of material was available for comparison, together with specimens of the European *A. cuneifolium*. Help was also available with other difficult species in both *Asplenium* and *Polystichum*, and in the latter genus particular attention was paid to the identification of hybrids by spore examination.

A. Sleep

EUPHRASIA

The genus *Euphrasia* in Europe consists of a successful group of hemiparasites of a diverse range of grassy, herb-rich habitats, including marshes, saltmarshes, heather moorland, base-poor to base-rich grassland, sea-cliffs and mountain ledges. Numerous morphologically distinct ecotypes exist, some of which have a wide European range. It is convenient to recognize at least the major taxa as separate species, though breeding barriers are often weak or non-existent and the distinctness of the taxa is maintained largely by habitat separation. The British Isles have 21 of the currently accepted 48 European species and with ever-changing patterns of land-use and disruption of habitat-boundaries, the genus shows a complex pattern of hybridization and evolution of local taxa. A flexible approach to the genus was encouraged and the workshop took an ecological view of the major taxa and attempt to define the morphological characters and habitat requirements of the recognized species. The problems of the local recorder, who may be faced with numerous populations that do not readily fit any single species, were discussed, as was the treatment of *Euphrasia* in recording schemes.

A. J. SILVERSIDE

INTERPRETING THE CHARACTERS OF THE CHARACEAE

Students of the Characeae have long indulged in discussion as to the validity of many of the supposed species. Since the publication of the standard work for the British Isles (J. Groves & G. R. Bullock-Webster, *The British Charophyta* (1920 & 1924)), the group has been the subject of a major, world-wide revision (R. D. Wood, *Monograph of the Characeae*, (1965)) which has reduced the number of species reported from these islands by half. Wood questioned the taxonomic significance of many of the characters previously considered important in separating species, but his views have not been accepted by the majority of the European workers, who remain traditionalists. A further dimension has been added to the debate by experimental workers (notably V. W. Proctor) whose success with laboratory cultures and breeding experiments has both clarified and confused the situation. In preparing a Handbook to the Characeae of the British Isles, the author has re-evaluated the 40 or so taxa recorded, adopting a mainly traditional approach in interpreting the characters examined but tempering this with a regard to the work of Wood and the experimentalists.

J. A. MOORE

INFORMAL EVENING SESSION

OPERATION GROUNDWORK: WILDLIFE IN THE URBAN FRINGE

A detailed botanical survey has been carried out in the boroughs of St Helens and Knowsley, Merseyside. A brief description of the methods used was given, especially of a new system tested on the urban areas. The rural area is dominated by intensive barley production, while in the urban areas much open space is 'ryegrass desert' or species-poor rough grassland. There are some remnants of semi-natural vegetation including acidic grassland, brook communities and a fragment of 'heath'. Secondary habitats include some rich meadows, a number of 19th century plantation woods and many marl pits, which together hold much aquatic life. However, many of the most interesting plants are found on derelict industrial land. St Helens has a large and varied collection of such sites, e.g. maritime species on drainage from waste heaps, calcareous grassland on Leblanc process waste, orchids on sand waste, acidic flora on colliery shale, marshes, abandoned dams, railways and the canal. A number of the species found on such sites are locally uncommon or rare – or would be if there wasn't so much derelict land in north-western England.

H. J. ASH

CURRENT RESEARCH INTO CRITICAL GROUPS

THE STATUS OF *EPIPACTIS LEPTOCHILA* AND *E. DUNENSIS*

Epipactis leptochila and *E. dunensis* are two very closely related, largely autogamous helleborines. They were formerly thought to be ecologically, distributionally and morphologically distinct; *E. leptochila* is a woodland plant of southern England and from northern France to Denmark, with a narrow, acute, patent epichile. *E. dunensis* is endemic to sand-dunes in England and Wales, and has a broad, short, subobtuse, recurved epichile. The only other morphological feature by which they differ statistically is sepal length, which usually exceeds 10 mm in *E. leptochila*, but is shorter in *E. dunensis*. *E. muelleri*, from central Europe is a woodland plant which is virtually indistinguishable from *E. dunensis*. *E. leptochila* var. *cordata* is probably the same plant.

Since 1974, about 15 inland populations of *Epipactis* have been discovered, chiefly on lead and zinc polluted sites under birch in Lincs., Yorkshire and Northumberland. These vary within and between populations in epichile posture and dimensions and sepal length, and contain individuals which are indistinguishable from southern *E. leptochila*, and those which cannot be separated from *E. dunensis*/*muelleri*. It is concluded that *E. dunensis* cannot be maintained as a species, and it is suggested that *E. dunensis* is returned to varietal rank as *E. leptochila* (Godf.) Godf. var. *dunensis* T. and T. A. Stephenson (*J. Bot.* **59**: 205, 1921).

A. J. RICHARDS

DEFINING AND DELIMITING DACTYLORCHID TAXA

Classical taxonomic methods have proved inadequate for dealing with the extensive morphological variation exhibited by dactylorchids (genus *Dactylorhiza*) within the British Isles. The resulting controversies surrounding the classification and nomenclature of these plants have been compounded by: 1) major differences of opinion over the meaning of taxonomic ranks, 2) erroneous descriptions based on unrepresentative data, and 3) a failure to place British populations within a European perspective. Multivariate analyses based on c. 50 morphological characters sampled from 87 dactylorchid populations have enabled the variation within this genus to be quantitatively expressed, and have led to a more objective delimitation of taxa based on morphometric, distributional and ecological criteria.

R. M. BATEMAN & I. DENHOLM

IDENTIFYING BRITISH BROME-GRASSES

Although only a fragment of the genus, 22 species of *Bromus* are likely, in varying degrees, to be encountered in Britain. Many of them present puzzling variation or are downright awkward. The lecture gave delegates the opportunity to consider some of these taxa, including some of the most 'difficult' species pairs and groups, side by side. Some of the differential characters are hard to communicate by mere words and delegates were asked to test out a new, draft key to British material. New characters from spikelet morphology were illustrated. There was a brief analysis of the reasons for the critical nature of some of these species. They include the breeding system, developmental variation, environmentally induced plasticity, hybridization and the sheer smallness of some of the differences. Inevitably, what can be done by way of circumscription has to take into account the variation seen as well as the reasons so far established (by experiment for instance) for at least some of it.

P. M. SMITH

GETTING TO GRIPS WITH *RUBUS*

The large number of local variants, named and unnamed, that exists in this group calls for a chain of people versed in the *Rubi* of limited areas. Many of these variants will be unknown to the national referees, and some means needs to be devised of enabling local specialists to examine each other's unnamed material. The matching of the recently-described *R. norvicensis* of the Norwich and Ipswich districts with a bramble long known round Romsey in Hampshire suggests that even floristically very different areas may prove to have species in common. More locally-based work might be forthcoming if the genus were not seen as prohibitively difficult. The difficulties, however, tend to be exaggerated. It is mainly in south-eastern England that the number of species becomes bewildering: over much of the British Isles reasonably widespread ones are comparatively few and their distribution patterns are more clear-cut. Given a good visual memory and a necessary period of intensive field study, the principal local forms can normally be mastered inside a season in these latter areas. Complications are caused by the frequency with which a number of species hybridize and by the variability of many under different environmental conditions. Unfortunately the only recent monograph, W. C. R. Watson's *Handbook of the* Rubi *of Great Britain and Ireland* (1958), confuses almost as much as it helps.

D. E. ALLEN

HYBRIDIZATION: CRITICAL GROUPS

IDENTIFYING HYBRIDS

Problems encountered in identifying hybrids are mostly the result of the nature of the hybrids themselves, or of the would-be identifier's poor understanding of it. The rule-of-thumb that hybrids are intermediate and sterile works some of the time, but not all of it. With regard to sterility, most hybrids are quite highly sterile, but most are fertile to some extent, and many are quite highly and a few fully fertile. Equally, sterility exists commonly in nature from a wide range of causes other than hybridity, e.g. adverse weather, lack of pollinators, lack of compatible pollen. With regard to intermediacy, most hybrids are intermediate to varying degrees, but many are much closer to one of the parents, and some are identical to one or other and some look unlike either. The results of crosses between two individual plants often show a wide range of variation, only some of which might conform with what we recognize as a hybrid. As a result, our determination of hybrids will sometimes be accurate, sometimes an underestimate and sometimes an overestimate. The only certainty is that we can never be 100% sure, because we can never re-create a particular hybridization event.

C. A. STACE*

IDENTIFICATION IN *RANUNCULUS* SUBGENUS *BATRACHIUM* AND CURRENT WORK ON *RANUNCULUS PENICILLATUS*

A new tabular key to species in *Ranunculus* subgenus *Batrachium* was distributed, with a request for help with testing the key in the field. A tabular key is particularly useful in this group because it enables identification to be based on all available features and incomplete material can be identified as accurately as possible. Characters used in the key were discussed and illustrated. Hybridization within the group not only presents difficulties for identification, but also plays an important evolutionary role. The *Ranunculus penicillatus* group is thought to have arisen as amphidiploid hybrids between *R. fluitans* and *R. peltatus*, *R. aquatilis* or *R. trichophyllus*. Within *R. penicillatus*, three varieties – var. *penicillatus*, var. *calcareus* and var. *vertumnus* – are currently recognized. Var. *penicillatus* differs from the other two varieties in having the capacity to form

* Unfortunately Dr Stace was unable to present his paper at the Conference and, at very short notice, Mr D. E. Allen volunteered to contribute his paper on *Rubus*.

laminar leaves, whilst vars *calcareus* and *vertumnus*, which produce only capillary leaves, intergrade morphologically. In addition, var. *penicillatus* is ecologically distinct, occupying base-poor rivers in Ireland and western Britain, whereas both var. *calcareus* and var. *vertumnus* generally occupy base-rich rivers and occasionally share a habitat. Var. *penicillatus* also appears to have a different, if overlapping geographical distribution from the other two varieties, although this difference may be determined largely by ecological preferences. These results suggest that var. *penicillatus* merits separation from the other two varieties at subspecific rank, whilst both var. *calcareus* and var. *vertumnus* should be retained within a second subspecies.

S. D. Webster

RECENT ADVANCES IN THE STUDY OF *TARAXACUM*

Since the publication of *The Taraxacum Flora of the British Isles* (Richards 1972), considerable inroads have been made into our understanding of the British status of this problematic genus. The sectional taxonomy has recently been revised and this has been of considerable value to the student. In addition, our knowledge of the *Taraxacum* flora has doubled the number of species since that of Richards' publication.

The workshop concentrated on the following aspects, supported by the use of appropriate material:

- Hints on the collection, preservation, presentation and identification of dandelions.
- An outline of the 'problem' nature of the genus.
- Description and demonstration of the diagnostic features of the nine sections found in the British Isles and some discussion of their inter-relationships.
- A review of our current understanding of the composition and distribution of the species known in Britain.

C. C. Haworth & A. J. Richards

MENTHA SPECIES AND HYBRIDS IN BRITAIN

In common with other perennial cultivated groups, the mints are difficult to treat taxonomically and difficult to identify. Of the six species occurring in Britain, four are native in part of their range. These are *M. aquatica*, *M. arvensis*, *M. suaveolens* and *M. pulegium*. The last, and also the introduced Corsican *M. requienii*, do not normally cause identification problems. Most problems are caused by *M. spicata*, the Garden Spearmint, belonging to sect. *Mentha* as do the first three species mentioned above and among which hybrids occur frequently. The relationships of these species were discussed and the importance of careful observations in the field and, if possible, in cultivation, was underlined. The value of traditional characters for identification was considered, together with others such as scent, epidermal hairs, sex and fertility. It was pointed out that a range of characters should be assessed together when dealing with possible hybrids between genetically very variable species, as often no hard-and-fast rules can be drawn up for their identification. As with many critical, polymorphic groups, local variants are worth recognizing at least informally, as they can provide evidence of means of vegetative spread and dispersal, and their history and origin may sometimes be possible to unravel. In many cases these variants are impossible to treat in formal taxonomic terms, when considered against the total variation encountered in the species or hybrid as a whole.

R. M. Harley

DACTYLOID SAXIFRAGES

The Dactyloid Saxifrages of the British Isles are currently classified into four species, *Saxifraga cespitosa, S. rosacea, S. hartii* and *S. hypnoides*. Recent research has both questioned and confirmed certain aspects of this classification. An example of this is that cytological work has shown the group to have a chromosome base number of x = 13. *S. cespitosa* is hexaploid (2n = 78) and *S. rosacea* and *S. hartii* are tetraploid (2n = 52). *S. hypnoides* has been found to consist, throughout its range (Iceland, Faeroes, British Isles, north-eastern France), of two geographically separate chromosome races, a tetraploid (2n = 52) and a diploid (2n = 26). This total separation of chromosome races suggests that they are biologically separate species. In proposing this taxonomic change, a problem arises because the morphological differences between the two cytotypes are slight. The only possible definitive characters are based on cell size (and chromosome number) and thus a microscope needs to be used for identification. The most effective character was found to be stomatal guard cell diameter. The demonstration illustrated the situation with *S. hypnoides* and presented information on geographical distribution which is currently the best method of separating the two cytotypes. *S. rosacea* and *S. hartii*, although having a consistent chromosome number in the populations that have been studied, show characters that particularly question the specific rank currently afforded *S. hartii*. This species was described from material collected on Arranmore Island, Co. Donegal. Recent collections of plant material from this island proved to be a further variant of *S. rosacea*, with some affinity to the variant found on Clare Island to the south. It was concluded that *S. hartii* should be included within the variable *S. rosacea* but that fieldwork was necessary on Arranmore Island in order to confirm this. The demonstration showed the variability of *S. rosacea*, including the population from the Burren and Aran Islands, Co. Clare, which has the most claim to be treated as a separate subspecies or species.

D. M. Parker

ROSA

As a critical group of plants, roses are more akin to willows than say to brambles or hawkweeds. The taxonomic solution to their diversity appears to lie in recognizing hybrids between a few species rather than in characterizing many microspecies. This is often difficult and complicated by the unique genetic performance of at least the British members of this genus during sexual reproduction, a process which leaves the genetic factor of the female parent predominant. Unfortunately, in the past, varietal and even species names have been allocated to many taxa which we should now recognize as hybrids. *Flora Europaea* adds to the confusion, and the treatment of roses in this work was compared with that of Wolley-Dod (A revision of the British roses, in *J. Bot., Lond.*, **1930–31**, supplement, 1931), Clapham, Tutin & Warburg (*Flora of the British Isles*, 2nd ed., 1962), and Melville (in Stace, C. A. (ed.), *Hybridization and the flora of the British Isles* 1975). The main British species as well as some common hybrids were discussed and characters of use in recognizing hybrids were pointed out. Recording from herbarium specimens is often dubious. Field observation is paramount in the study of this genus, and fresh fruiting material was used to illustrate the session.

G. G. Graham

COMPUTER WORKSHOP

CARMARTHENSHIRE FLORA PROJECT, DOT-MAP PLOTTING PROGRAM

The use of a Sinclair Spectrum linked to a suitable dot-matrix printer to produce good quality species distribution maps was demonstrated. The operator manually input each record to be plotted and selected the appropriate map symbol to signify the particular status (e.g. post-1970, native). Maps so constructed were saved to tape for subsequent recall and update and were of sufficient quality to be ready for publication. The major disadvantage with the method was that records needed to be abstracted manually from the master card-index before plotting, a very time consuming business.

Future advances were demonstrated at informal evening sessions. Using a B.B.C. Model B computer an innovative database has been developed which allows rapid and easy input by displaying on the screen species lists derived from the Nature Conservancy Council's Wales field card. Plants recorded are selected by the cursor, a method which also allows status and habitat information to be appended to each species. The economic use of the machine's memory enables the complete vice-county database of nearly 700 tetrads to be stored within the 1·3 megabytes available on two double-sided floppy discs.

Interrogation of the database is very flexible. The present hardware takes about ten minutes to search the whole and plot a distribution map for the selected species or combination of species. Other enquiries can, for example, produce a list of species for a given tetrad or group of tetrads, sum the number of species recorded in a tetrad, plot recorded habitats, list species by status, etc. The use of hard disc or sideways RAM would significantly increase the speed of interrogation.

The system is adaptable to any county or area and to any floral or faunal group. A database to store higher-plant data for the whole of Wales by 10-km-squares is already under development.

R. D. PRYCE

FLORA OF CUMBRIA DATABASE

A series of interactive computer programs (in FORTRAN 77) has been written to maintain and utilize a database which contains species records catalogued by the tetrads in which the species occurs. Program FILESPP is responsible for the input of new records into the database and has facilities for checking, as far as possible, the accuracy of the data entered.

Program SELECTSPP interrogates the database to extract the following information:

i) Compile a list of tetrads in which a given species occurs and produce a distribution map.
ii) Compile a list of tetrads in which a given combination of species occurs, and produce a distribution map for that combination.
iii) Compile a list of tetrads which have a total number of species lying between given limits, e.g. tetrads with 150–200 species, and produce a distribution map.
iv) Compile a list of species in a given tetrad.
v) Compile a list of species in a given group of tetrads.
vi) Compile a list of species found in a given number of tetrads, e.g. a list of species in 10–15 tetrads.
vii) Compile a list of species-totals in each tetrad in the database. The maps produced are of sufficient quality to be ready for publication.

A. J. C. MALLOCH

W. LANCASTER FLORA: USE OF A B.B.C. COMPUTER

A survey of the flora of West Lancaster (v.c.60) was started in 1964. At that time and for many years afterwards the use of computers was not contemplated. As publication of a new Flora approaches, the B.B.C. microcomputer has been utilized for capturing dot-map distributional data for onward transmission and map production using the Flora of Cumbria Database at Lancaster University. The B.B.C. microcomputer is also used as a word-processor for the production of text.

E. F. GREENWOOD, P. W. PHILLIPS & J. RAVEST

IDENTIFICATION BY COMPUTER

Computer programs for interactive identification on the BBC-B and TORCH microcomputers were demonstrated. Examples were shown of sets of data relating to the critical genera *Rubus*, *Taraxacum* and *Euphrasia*, as well as a set for grasses with vegetative characters only.

R. J. PANKHURST

THE NORTH WEST BIOLOGICAL FIELD DATA BANK'S CATALOGUING SYSTEM

The North West Biological Field Data Bank holds information on nearly 2,000 sites in north-western England. The workshop demonstrated the use of the commercial programme dBase II to construct the catalogue of these sites. On-line retrieval of the data was demonstrated and the use of command files which allow the database to be used by the computerphobic person was explained. Further expansion possibilities were described and some other commercially available database programmes for micro-computers were also mentioned.

A. S. GUNN

THE USES OF CRITICAL RECORDS

FLORA RECORDING AND THE NATIONAL VEGETATION CLASSIFICATION

The National Vegetation Classification is providing a systematic and comprehensive description of all the vegetation in natural, semi-natural and major artificial habitats in Great Britain. From its results it will be possible to produce a phytosociological profile for a large proportion of the British vascular flora as well as for many bryophytes and lichens. It is hoped that the National Vegetation Classification will encourage flora-recorders to set their observations in an ecological context and serve as a framework for research on the conservation of individual taxa.

J. RODWELL

THE ROLE OF CRITICAL SPECIES RECORDING IN EVALUATING SITES OF SPECIAL SCIENTIFIC INTEREST

Biological Sites of Special Scientific Interest are usually notified on grounds of habitat or plant communities for which the Nature Conservancy Council uses guidelines based on the concepts of the *Nature Conservation Review* (1977): naturalness, diversity, size, rarity and fragility. This picks up most good botanical sites, but there is also provision for S.S.S.I.s to be notified on grounds of individual species or assemblages of species alone, both for animals and plants. For plants on Schedule 8 of the *Wildlife and Countryside Act 1981*, that is 'Red Data Book' (*British Red Data Book 1. Vascular Plants*, 2nd ed. (1983)) species which require special protection, the policy is to notify all localities. For all other vascular plants, an assemblage score of 200 or more is used as a guideline, which includes use of critical species. The remaining 'Red Data Book' species score 100, species occuring in 16–30 10-km-squares in *Atlas of the British Flora* (1962) and *Critical Supplement to the Atlas of the British Flora* (1968) score 50, 31–100 squares score 40. The Council is not bound by the score and single species localities (including critical species) of particular note: British endemics, species rapidly declining, those with fewer than six locations in Britain, and species at the edge of their range receive special attention and may merit notification. The Council's capacity to use critical groups in evaluating S.S.S.I.s is limited by the information available about their distribution. It would like to have better information to facilitate this process.

N. A. ROBINSON

CRITICAL SPECIES AND NATURE CONSERVATION

The objective of plant conservation in Britain must be the protection of our native taxa in their original habitats. This is of particular importance for critical species groups or infraspecific taxa where endemic variants have evolved since the separation of these islands from the Continent.

These taxa present several difficulties because they are recognized by a very small number of specialists:

1. What are the taxa? Which specialists do we follow?

2. Where are the taxa? Who can collect distribution information over a short enough period for an assessment of their status to be made?
3. What are the management requirements? Can site managers recognize the taxa and have adequate knowledge to ensure their survival?
4. How can the Law be enforced? Should critical taxa be scheduled under the *Wildlife and Countryside Act 1981*? Would ignorance of identity be a defence for picking a critical taxon?
5. In the light of these difficulties and the scientific importance of these taxa, decisions have to be made on the number of sites for each we should be seeking to protect; we may find out, with the help of experts, how many sites for each are already protected; and consider the role of botanic gardens/universities in gathering and monitoring living collections of taxa within nominated groups.

The relevance of collecting data for further editions of the *Atlas of the British Flora* (1962) and the *Critical Supplement to the Atlas of the British Flora* (1968) and the monitoring of change in the distribution of critical taxa must also be considered.

F. H. PERRING

FIELD EXCURSIONS TO NESS GARDENS AND RED ROCKS, 14TH SEPTEMBER 1985

The field excursion on Saturday, 14th September visited two quite different areas. In the morning, Dr H. McAllister, Deputy Director of the University of Liverpool's Botanic Gardens at Ness, South Wirral, Cheshire welcomed delegates and took them on a guided tour of the Gardens. There was far too much for delegates to see on one trip and certain features were selected for special comment. These included the national collection of willows recently transferred from Long Ashton Research Station, Bristol, taxonomic studies on *Orobanche*, and the native plant garden where a number of endangered British species are grown.

In the afternoon, delegates drove a few miles north-westwards to the coast of the Wirral peninsula at West Kirby. Here the Red Rocks S.S.S.I., managed as a nature reserve by the Cheshire Conservation Trust, was visited. It is a small area of sand dunes with a brackish slack and reedbed, and developing saltmarshes adjoining the site. In continuing the critical groups theme of the conference, *Atriplex littoralis*, *A. prostrata*, *A. glabriuscula* and *A. laciniata* were distinguished. In a new developing slack *Juncus ranarius* was noted and distinguished from *J. bufonius* sensu stricto growing further inland. A feature of Red Rocks is the presence of *Equisetum* × *trachyodon*, and considerable discussion took place when distinguishing this hybrid from *E. variegatum*, which it was thought was growing as a robust upright variant in a nearby dune slack. The other parent, *E. hyemale*, formerly occurred here but has not been seen for many years. The meeting finally ended after a developing *Salicornia* marsh was examined, where *S. ramosissima*, *S. fragilis* and *S. dolichostachya* were identified.

E. F. GREENWOOD & H. MCALLISTER

EXHIBITION MEETING, 1985

The Annual Exhibition Meeting was held in the Department of Botany, British Museum (Natural History), London, on Saturday, 30th November 1985, from 12.00 to 17.30 hours. The following exhibits were shown.

SOME ADDITIONS TO THE FLORA OF EUROPE

The exhibit illustrated some of the new information that is being assembled for the revised edition of *Flora Europaea* Volume 1, currently being prepared at Reading University. Herbarium material and maps were displayed of taxa that have been reported as native to Europe, or

naturalized aliens, since the publication of *Flora Europaea* Volume 1 in 1964. The examples shown were:
–*Arenaria pomeli* Munby, an annual species formerly thought to be endemic to Morocco, but now known from southern Spain;
–*Chenopodium pumilio* R.Br., an alien from Australia that is naturalized in western and central Europe;
–*Crassula alata* (Viv.) Berger, similar to *C. tillaea*, recently found on Crete and in the Cyclades, which has its main distribution in N. Africa and the Middle East;
–*Polygonum lanigerum* R. Br., a species of the Old World Tropics that extends to the Middle East, reported in southern Crete;
–*Rumex vesicarius* L., an annual species that has been refound at its only European station at Nafplion in southern Greece;
–*Tellima grandiflora* (Pursh) Douglas ex Lindley and *Tolmeia menziesii* (Pursh) Torrey & A. Gray, saxifragaceous species from Pacific N. America, which are becoming established in shady places in the British Isles.

J. R. AKEROYD

SOME RECENT *RUBUS* DISCOVERIES IN HAMPSHIRE

By 1983, 115 *Rubus* species were reliably on record from v.c. 11 and/or v.c. 12. In the following year, five more species were added, their Hampshire occurrences representing in each case startling extensions of their known British ranges.
–*R. hastiformis* W. C. R. Wats., locally abundant in Cornwall and Devon, with rare outliers in Glamorgan, Cardiganshire and Sussex;
–*R. leptothyrsus* G. Br. (*R. danicus* (Focke) Focke), a common Scottish species, not previously known south of Suffolk and Herefordshire;
–*R. norvicensis* A. L. Bull & Edees, known since 1972 in abundance in woods and hedges around Romsey, extending to Winchester and Southampton, and in copses on Hayling Island. In 1984, a chance look at the **BM** holotype of this recently described species of the Norwich and Ipswich districts suggested the two might be identical, a hypothesis confirmed by A. L. Bull;
–*R. tumulorum* Rilst. (not exhibited), formerly believed to be confined to the Looe district of south-eastern Cornwall and one or two places in Devon;
–*R. winteri* P. J. Muell. ex Focke, believed to be restricted to the central and east Midlands of England. In 1984–85 it was found in copses on chalk in three widely separated parts of Hampshire, one of them by the border with S. Wilts., v.c. 8, into which it probably continues.

Also exhibited was the holotype (**BM**) of *R. hantonensis* D. E. Allen, described in *Watsonia*, **15**: 387 (1985), so far known only in Hampshire and the Isle of Wight.

D. E. ALLEN

DISTINGUISHING BETWEEN *BETULA PENDULA*, *B. PUBESCENS* AND THEIR HYBRIDS

Betula pendula Roth (2n=28) and *B. pubescens* Ehrh. (2n=56) can be separated reliably using three leaf characters: leaf tip width, 'leaf tooth factor', and distance to the first tooth on the leaf base. This identification is carried out by using a discriminant function. Hybrids are identified as *B. pubescens* by this method. Artificial hybrids can also be distinguished from both parent species by using a pair of discriminant functions involving nine leaf characters. Stomatal length varies between *B. pendula*, *B. pubescens* and the hybrids, those of *B. pendula* being the smallest and those of the hybrids being intermediate.

M. D. ATKINSON & A. N. CODLING

SEED-SET IN BRITISH *REYNOUTRIA* POPULATIONS

Members of the rhizomatous, perennial genus *Reynoutria*, giant knotweeds, are now established members of the flora of the British Isles. As part of a study carrying on from A. P. Connolly's work on the genus, an examination of the reproductive biology of these plants has been undertaken. *Reynoutria japonica* was found to have 88 chromosomes, and *R. japonica* var. *compactum* and *R. sachalinensis* 44 chromosomes. Two groups of hybrids were found to have 44 and 66 chromosomes. In order to examine the role played by seed set, seeds and parental rhizomes were collected from a number of localities in the British Isles, and chromosome counts performed on the plants that were raised. A most surprising result is that the majority of seedlings from parents with 88 chromosomes had 54 chromosomes. These plants are thought to be hybrids with *Fallopia aubertii*, Russian Vine (2n=20), as the male parent.

J. P. Bailey

× *ORCHIACERAS BERGONII* (NANTEUIL) CAMUS: A BIGENERIC HYBRID NEW TO BRITAIN

Bigeneric hybrids between *Aceras anthropophorum* (L.) R. Brown and species of the genus *Orchis* subgenus *Militares* are often recorded on the Continent, especially × *Orchiaceras bergonii* (Nanteuil) Camus (*A. anthropophorum* × *Orchis simia* Lamarck). The first British specimen of this hybrid (also the first involving *Aceras*) was discovered during 1985 in Kent, at the only British locality where its parental species co-exist. Its identity was confirmed by detailed morphometric comparison with its parents, using multivariate analyses, but its origin remains speculative. Photographs and sketches of the hybrid and its parents were exhibited, and implications of the morphometric study were outlined.

R. M. Bateman & O. S. Farrington

BRITISH PLANTS AS ALIENS IN MALAYSIA

Specimens were shown of a number of plants from peninsular Malaysia which also occur in Britain. Most of these are weedy species of disturbed soils above 100 m altitude. The following 29 species were noted in 1976 and/or 1985; only those marked * are mentioned in current Floras and the rest may be new records: *Alopecurus aequalis, Artemisia vulgaris, Briza minor, Cardamine hirsuta, C. flexuosa, Cerastium fontanum, C. glomeratum, Chrysanthemum segetum,* **Cynodon dactylon,* ?*Fragaria vesca, Galinsoga parviflora,* **Gnaphalium luteo-album, Hypochoeris radicata, Juncus bulbosus,* **Oxalis corniculata,* **Plantago major,* **Poa annua,* **Pteridium aquilinum, Raphanus sativus, Rumex crispus, Sagina procumbens, Sambucus nigra,* **Setaria geniculata,* **Solanum nigrum, Sonchus oleraceus,* **Stellaria media, Trifolium dubium,* ?*Vulpia bromoides, V. myuros*.

H. J. M. Bowen

HAMPSHIRE HIGHLIGHTS, 1985

This exhibit reported notable records within the county during 1985 of flowering plants & ferns. It was illustrated with herbarium material kindly loaned by the British Museum (Natural History) & A. R. G. Mundell, and with specimens provided by the exhibitors.

Plants reported from the geographical county for the first time (or which had apparently become extinct from all known sites) were *Allium oleraceum* L., *Berberis aggregata* Schneid., *Carex elongata* L., *Cotoneaster dielsianus* Pritz., *Cotoneaster frigidus* Wall., *Cotoneaster perpusillus* (Schneid.) Flinck & Hylmö, *Cotoneaster salicifolius* Franch., *Cotoneaster* × *watereri* Exell, *Papaver dubium* L. × *P. rhoeas* L., *Potamogeton coloratus* Hornem., *Ruscus hypoglossum* L., *Salvia reflexa* Hornem., *Setaria pumila* (Poiret) Schultes. and *Sisyrinchium iridifolium* subsp. *valdiviense*.

New vice-county records were *Equisetum hyemale* L. (v.c. 12), *Phacelia tanacetifolia* Bentham (v.c. 11), and *Typha* × *glauca* Godr. (v.c. 12). Other rare plants that were seen to thrive in the county during 1985 were *Briza minor* L., *Gastridium ventricosum* (Gouan) Schinz & Thell., *Lycopodiella inundata* (L.) Holub, *Polypogon monspeliensis* (L.) Desf. and *Himantoglossum hircinum* (L.) Sprengel (seen for the first time since 1948).

A. Brewis, J. D. Fryer, B. A. Gale & F. Rose

SOME MORE BRITISH SPECIES FROM THE WESTERN HIMALAYA

Herbarium sheets of the following species, found both in Britain and the western Himalaya, were displayed:

Campanula latifolia (Ludlow & Sheriff, 1940), widespread in Pakistan and Kashmir, 2700–3700 m; *Lotus corniculatus* (Polunin, 1956), widespread, 1200–3200 m; *Dactylis glomerata* (Polunin, 1956), very common and variable, from Chitral eastwards, 2–400 m; *Veronica beccabunga* (Robson, 1971), found at springs and stream margins, 1800–3500 m; *Achillea millefolium* (Polunin, 1956), very common in the temperate and lower alpine zones, 1600–4000 m; *Oxyria digyna* (Southampton University Botanical Expedition, 1981), very common in wet soil at high altitudes, 2700–5400 m; *Hippuris vulgaris* (Zino, 1978), cool waters of the northern hemisphere, 1200–4500 m; *Adoxa moschatellina* (Duthie, 1892), forest humus, 2700–3500 m; *Convolvulus arvensis* (Southampton University Botanical Expedition, 1981), a common weed of fields.

C. Chadwell

THE HAY-MEADOWS OF THE PICOS DE EUROPA, ASTURIAS, SPAIN

The Picos de Europa in northern Spain contain a large number of species-rich hay meadows which are managed in a traditional manner. In May 1985 the students and staff of the Conservation Course M.Sc. at University College London visited the area to study the meadows. The rich plant communities were recorded and the specific management carried out to produce the meadow flora was determined from the local farmers. Spain's entry to the E.E.C. in 1986 may cause the management of these meadows to be altered. Four scenarios were proposed for the future of the meadows. Some of the options available which would lead to the conservation of the haymeadows were discussed. The text of the exhibit was a condensed version of "The Hay Meadows of the Picos de Europa", Discussion Paper in Conservation, no. 43, Conservation Course, 1985, U.C.L., augmented by photographs and herbarium specimens.

A. Colston

THE GENUS *OROBANCHE* IN THE BRITISH ISLES

The broomrape genus *Orobanche* is represented in the British Isles by a number of local or rare species with very restricted host ranges, and by a more frequent species, *O. minor* Sm., that parasitizes several dicotyledonous hosts of diverse phylogenetic origin. However, due to the lack of precise morphometric data, the characters that best separate *Orobanche* species are still inadequately defined; as a result the specific identity of some broomrape populations parasitizing *Daucus carota*, *Picris hieracioides* and *Eryngium maritimum* in southern England and Wales is presently in doubt. This photographic exhibit depicted the native *Orobanche* taxa recorded from the British Isles, summarized their known distributions and host ranges in the country, and served to highlight existing areas of controversy within this taxonomically difficult group. Additional records of broomrapes on unusual hosts or outside their accepted geographical ranges were requested.

I. Denholm & M. Jones

QUINQUENNIAL REVIEW 1985

During 1985 a field survey of most of the 62 species scheduled under the *Wildlife and Countryside Act 1981* has been carried out. Many other species were considered on request from B.S.B.I. members, N.C.C. staff and other botanists. A list of the species researched, and the criteria used was displayed, together with the recommendations to be given to N.C.C. Council and then to the Secretary of State. It was proposed to add 15 species and to delete one, as it has become extinct. Members were asked for their comments. Distribution maps showing the decline of *Mentha pulegium*, *Pulicaria vulgaris* and *Teucrium botrys* were displayed along with colour pictures of many of the species surveyed.

L. FARRELL & P. WILSON

TOLYPELLA PROLIFERA (ZIZ & BRAUN) LEONH. AT AMBERLEY WILD BROOKS, WEST SUSSEX (V.C. 13)

On 19th August 1985, while assisting Sussex botanists who record regularly at Amberley, I found *Tolypella prolifera* growing with *Groenlandia densa* in a ditch on the south side of the brooks. This species has been recorded from recently cleared ditches and ponds in about a dozen vice-counties, notably Cambridge, Huntingdon, Lincoln and Northants. Always considered rare, its large size and spectacular appearance were apparent in the photographs shown. Specimens from Amberley and other parts of the Arun Valley (**BM**) show that the plant has been recorded in this area since 1900 but, like other stoneworts, its appearances are spasmodic and unpredictable. Most stoneworts require unpolluted water and the periods of low competition provided by regular ditch cleaning management, so it is particularly pleasing to find this interesting plant at a time when so much wetland habitat is being lost or degraded.

R. FITZGERALD

THE ECOLOGY OF ABNEY PARK CEMETERY, HACKNEY, AND ITS EDUCATIONAL POTENTIAL

Cemeteries in urban areas provide a unique habitat which is extremely valuable both for wildlife and as an educational resource. The 9 ha of Abney Park Cemetery are the only woodland in the London Borough of Hackney. The Cemetery was designed by William Hosking in 1840, and under the direction of George Loddiges developed into one of Europe's most varied arboretums. At present densely overgrown in places, it is in need of management, and the Borough Landscape Architect invited the Urban Spaces Scheme (Polytechnic of North London) to advise on the enhancement of the area's ecological and educational potential. The exhibit showed the early botanical history, current floristic composition, plans for future management and conservation, the geology of the gravestones, an Interpretive Guide, and the cemetery's grasses. A computerized "Town Grass Key" has been developed for children on a BBC microcomputer.

M. HALE

ECOLOGICAL SURVEY OF HAM RIVERSIDE LANDS, RICHMOND

This area of some 74 ha has long been of botanical interest, with a diversity of habitats including river bank, water meadows, gravel excavations and dumps. It is now a metropolitan open space within Richmond-upon-Thames, and various individuals and organizations are co-operating with the Parks Department to manage it as a recreational 'mini-countryside' with an important natural history content. The exhibit showed a series of photographs taken during the past 23 years and a recent detailed ecological study undertaken by students of the School of Horticulture at the Royal Botanic Gardens, Kew.

F. N. HEPPER

GURREHOLM BJERGE BOTANICAL EXPEDITION, 1985

The Gurreholm Bjerge Botanical Expedition was a joint British and Irish four-man venture which took place during July and August 1985. The aim of the expedition was to carry out floristic surveys of a number of previously unbotanized valleys and mountain ranges in the Ørsted Dal region of north-eastern Greenland. The flora of this region has comparatively few species (a total of 143 were recorded by the group). However those which do occur are of great interest, particularly as many of the common species (e.g. *Saxifraga oppositifolia* L. and *Betula nana* L.) are local alpine plants in the British Isles.

The exhibit illustrated a range of plants seen during the course of the expedition. Amongst the more notable finds were *Potentilla stipularis* L., an Asiatic species only found rarely in north-eastern Greenland, the sedge hybrid *Carex parallela* (Laest.) Sommerf. × *C. lachenalii* Schkuhr., and *Saxifraga nathorstii* (Dusén) Hayek which is endemic to this area of Greenland.

J. HOLDICH & D. A. SIMPSON

STAGES IN THE LIFE CYCLE OF *OROBANCHE CRENATA* FORSSKÅL

The genus *Orobanche* consists of some 150 or so species of obligate parasites. Much of their development takes place underground since their site of attachment is through the host root, and it is only when they flower (which for perennial species such as *Orobanche rapum-genistae* L. may be several years after seed germination) that they become apparent. For this reason the underground development of British broomrapes has received little attention from most botanists. The exhibit demonstrated the stages in the life cycle of a member of the genus *Orobanche* as shown by *O. crenata*. The stages were shown using preserved specimens, diagrams, and photographs. The role of *O. crenata* as an agricultural pest was also discussed.

M. JONES

DIOECY AND POLLINATION IN *VISCUM ALBUM*

Viscum album L. is dioecious, with marked differences in size and appearance between male and female flowers. Female plants have been found to predominate, with approximately twice as many females as males among flowering plants both in wild populations and among plants raised from seed.

Since 1762, when Koelreuter suggested that *V. album* was insect-pollinated, opinions have differed but there has been little evidence about the mode of pollination of its inconspicuous flowers. Recent workers have stated that it is wind-pollinated. However, observations in Herefordshire, where *V. album* is abundant, during March 1985 showed that both male and female flowers were visited by large numbers of Diptera, especially the common greenbottle, *Dasyphora cyanella*, apparently seeking nectar in female flowers (in which 0·02–0·04 μl of nectar with 48%–55% s.e. concentration was found) but seeking pollen in the nectarless male flowers. Flies caught on female flowers up to 6 m from the nearest male plant carried many *V. album* pollen grains. It was clear that the flowers of *V. album* are well adapted for insect pollination, which was fully adequate in the study area.

Q. O. N. KAY

HAWKWEEDS IN SOUTHERN SCOTLAND

Recent fieldwork has added considerably to the number of records of *Hieracium* species from southern Scotland (v.cc. 72–84), and 74 species have been recorded from the region on good authority. Most species are rare or local, although some are widespread and locally common. The usual habitat for the majority of species is cliffs and rocks, often by streams. Others may be found in grassland or on the edges of woods and a few in urban situations or on waste ground. It is likely that hawkweeds occur more widely in the region than is suggested by currently available records. Extra records from v.cc. 74–77 and 81–84, in particular, would go far towards producing a comprehensive picture of their distribution in southern Scotland.

D. J. McCosh

CONSERVATION SECTION, CAMBRIDGE UNIVERSITY BOTANIC GARDEN

The Nature Conservancy Council funds the propagation, display, seed-storage and autecological study of rare British plants in the Garden. Low temperature and moisture content provide seed-storage conditions under which viability can be maintained for years. A list of the contents of the seed-bank is available from the Conservation Propagator. As our populations are under such pressure, only those people specifically requested to do so by the N.C.C. should collect seed of wild Red Data Book species. Rare plants in cultivation can be used to inform visitors about conservation and the autecology of these species, and provide quality material for research scientists or re-introduction. These functions require rigorously careful documentation and labelling. Exhibited were notes and slides, also live and herbarium specimens of some of the species forming the Conservation Collection. Annual changes in the underground morphology of *Himantoglossum hircinum*, Lizard Orchid, were also illustrated.

V. M. Morgan

THE EAST HAMPSHIRE HANGERS PROJECT

Sponsored by the Countryside Commission, E. Hants. District and Hampshire County Councils, the Project aims to bring back into positive management the 680 ha of Hanger woodlands on the Chalk and Greensand scarps between Petersfield and Alton. Most of these are ancient woodlands, half are S.S.S.I.s.

Due to loss of traditional markets, the inaccessibility of the steep slopes, age and disease, the Hanger structure and landscape is deteriorating. The Project Officer aims to persuade owners to join management schemes, and he will organize grants and help to market produce. Because of the Hangers' unique and diverse biological richness, all are being surveyed initially; small-scale felling will be followed by recoppicing and natural regeneration to maintain stand-types and genetic stock, planting when necessary with native species. Visitors to the Project are very welcome: more information is available from the Project Officer, whose telephone number is Petersfield 66551.

J. Ockenden

THE GUERNSEY BAILIWICK, 1985

Herbarium sheets were shown of the more important finds of the year, viz: GUERNSEY: *Davallia canariense* – new to the Channel Islands (C.I.); *Ononis* cf. *alopecuroides* – new to the C.I.; *Symphytum* 'Hidcote Blue' – new to the C.I.; *Juncus bulbosus* f. *viviparus* – first find since the 18th century; *Bromus ramosus* – new to the C.I.; *Brachypodium pinnatum* – in two separate places, known otherwise in the C.I. only from Alderney; *Apera spica-venta* – last seen 1958. SARK: *Myosoton aquaticum* –again as a garden weed; *Stellaria graminea*; *Fragaria vesca* – unaccountably rare in the bailiwick; *Mentha* × *villosa* 'Alopecuroides'; *Luzula forsteri*; *Poa angustifolia*; *Phleum pratense*. HERM: *Conyza sumatrensis* – new to the Herm archipelago; *Chamaemelum nobile* – first find for 148 years; *Allium subhirsutum* – known otherwise in the C.I. only in Sark; *Alopecurus pratensis*. JETHOU: *Portulaca oleracea*; *Phytolacca* cf. *polyandra* – new to the C.I.;

Polygonum persicaria; *Agrostis stolonifera* – first record for 95 years; *Vulpia bromoides* – ditto; *Alopecurus myosuroides* – new to the Herm archipelago.

Also shown were sheets of *Silene vulgaris* subsp. *maritima* with double flowers, found at Jerbourg in 1984; and of this plant with a pallid calyx collected in 1910. Fuller accounts of both, with names for them will appear in the *Transactions of La Société Guernèsiaise* for 1985. In this there will also be the first Supplement to the "Wild Flowers of Guernsey", and the new Check-List for Herm, both available separately.

J. PAGE

ORIGINAL DRAWINGS FOR FRYER'S MONOGRAPH OF *POTAMOGETON*

Alfred Fryer began to study *Potamogeton* during the 1880s. He became an acknowledged authority on the genus, and the first parts of his monograph *The Potamogetons (Pond Weeds) of the British Isles* were published in 1898. He died before finishing the work, which was completed by A. Bennett. Fryer's section of the monograph was illustrated by Robert Morgan (1863–1900). Morgan's colour plates delighted Fryer and have been praised by later critics. Eight of his original drawings were exhibited, by kind permission of the British Museum (Natural History).

C. D. PRESTON

THE CARMARTHENSHIRE FLORA DATABASE: A COMPUTER DATA STORAGE AND RETRIEVAL SYSTEM ADAPTABLE FOR ANY HOME-BASED VICE-COUNTY RECORDER

Software to run on the B.B.C. Model B computer, written especially for vice-county recorders, was demonstrated. The database as set up for the Carmathenshire Flora Project will store the records for each of the 698 tetrads on only two floppy discs. The intended primary use of the system is as a tool to enable fast interrogation of the floral data and not to entirely replace the master card index. When inputting records, the program displays a series of screens of species lists, based on the Biological Record Centre's field card. Plants recorded are selected with the cursor and habitat and status information is appended to each. Interrogation of the database enables a variety of parameters to be extracted including, for example, the compilations of a list and plotting of a distribution map of tetrads in which a selected species or group of species occurs by date, status or habitat.

S. RHODES & R. D. PRYCE

CAPSELLA AND *CARDARIA* IN THE BRITISH ISLES

In a recent study of *Capsella* in Greece, Svensson (*Willdenowia* **13**: 267, 1983) showed that no morphological or cytological character could be used to distinguish *C. rubella* Reuter from *C. bursa-pastoris* (L.) Medicus. He concluded that *C. rubella* did not merit specific status and that it should be included within *C. bursa-pastoris* sensu lato. A less detailed survey of British *Capsella* shows many of the same features of variation observed in Greece. Specimens showing this variation were exhibited and the characters traditionally used to separate the species were listed and discussed.

Two subspecies of *Cardaria draba* (L.) Desv. have been introduced to the British Isles. Subspecies *chalepensis* (L.) D. E. Schulz is much rarer than subsp. *draba* and has been recorded from v.cc. 2, 39 and 70 (J. E. Lousley in *Proc. bot. Soc. Br. Isl.* **1**: 577, 1955). It is distinguished by its ovate siliculae which have cuneate to narrowly rounded bases. Specimens of the two subspecies were exhibited, and details of further sites and live or dried material were requested.

T. C. G. RICH

ISOZYME VARIATION IN SEXUAL AND ASEXUAL *TARAXACUM*

In northern Europe, all dandelions are asexual, being polyploid agamosperms with diplosporous parthenogenesis. In southern Europe, many dandelions are self-incompatible, diploid, sexual species. It is to be expected that sexuals are more genetically variable than asexuals, and possibly able to fill more environmental niches. This hypothesis was tested for 16 loci in eleven enzyme systems for an asexual population of *T. pseudohamatum* from Newcastle-upon-Tyne, and a sexual population, probably referable to *T. alacre*, from the Auvergne, France. The Mendelian inheritance of all varying loci was tested by experimental crosses in the sexual population.

In the sexual population, eight loci were polymorphic (50%), but the mean level of heterozygosity at each locus was only 12%. In the asexual population, only one locus was polymorphic (6%), but the mean level of heterozygosity at each locus was 43%. At five of the loci which were polymorphic in the sexual, only invariable fixed heterozygotes were found in the asexual population. One monomorphic locus in the sexual was also heterozygously fixed in the asexual. It is concluded that theoretical predictions of low genetic variability but high levels of heterozygous fixation (which might result in vigour) in asexuals are confirmed, at least in these populations.

A. J. Richards & J. Hughes

SPIRANTHES SPIRALIS (L.) CHEVAL. – FROM SEED TO FLOWERING PLANT IN 5 YEARS

The development of terrestrial orchids from seed to a flowering plant is generally considered to be a lengthy process, involving a long period as an underground protocorm. Summerhayes (1951) states that the first leaf is produced after 11 years in *Spiranthes spiralis*, with another 2–3 years before the plant flowers. In asymbiotic culture, we produced plants with leaves within 6 months after sowing, with a single plant producing an inflorescence within 5 years after transfer to a non-sterile shell-sand soil. While we accept that conditions in a culture tube are different from those encountered in the field, the exhibit suggested that the times for development from seed to flowering plant quoted in most standard works on orchids are excessively long and require re-assessment.

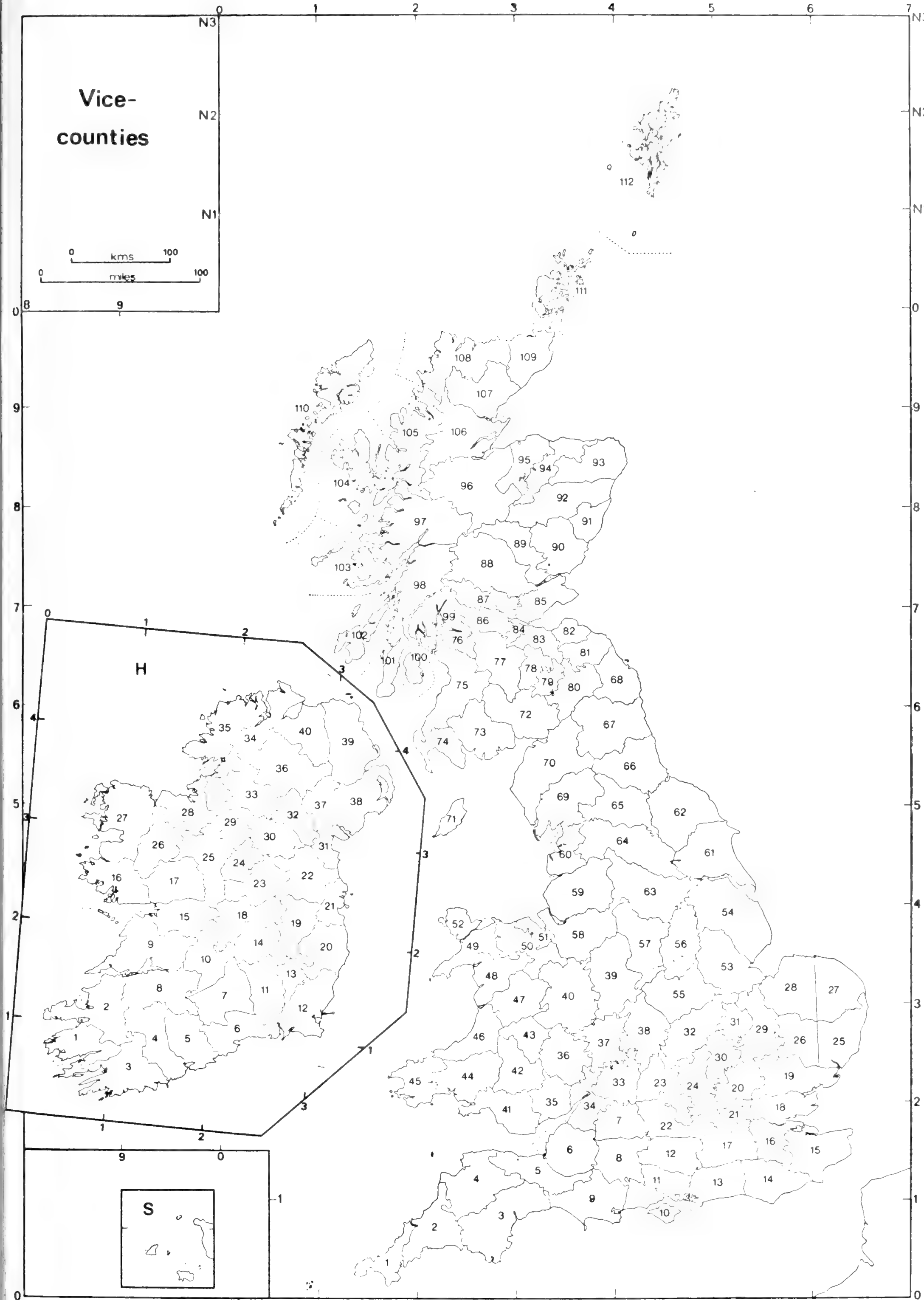
T. C. E. Wells & R. Kretz

The following also exhibited:

Botany Library, British Museum (Natural History). (a) Frank Kingdon-Ward, b. 6th November 1885; a centenary exhibition. (b) History of Botanic Gardens.
D. Burnham. Mutation in orchids.
A. J. Byfield. *Nitella mucronata* var. *gracillima* J. Groves & Bullock-Webster, a rare charophyte from Co. Avon.
J. H. Fremlin. Stereophotographs of some Irish plants, including *Minuartia recurva*.
A. N. Gibby. Botanical postage stamps.
A. C. Jermy, J. M. Camus & A. M. Paul. *Pilularia* in the British Isles.
A. C. Jermy & A. G. Kenneth. *Diphasiastrum* × *issleri* (Rouy) J. Holub in Scotland.
V. A. Johnstone. Photographs of wild flowers of southern England.
S. L. M. Karley. (a) Help! (b) Galls.
J. M. Mullin & A. Melderis. *Polypogon pumilus* Clarke in Britain.
D. M. Parker. The dactyloid saxifrages of the British Isles.
M. C. F. & M. E. Proctor. Scanning electron micrographs of *Carex* leaf-surfaces.
M. E. & M. C. F. Proctor. Fruit characters of Devon *Sorbus* species.
C. M. Saunders & St Christopher's School, Burnham-on-sea. Operation Orchid.
P. Sisson. A selection of botanical illustrations.
D. R. Slingsby. The Keen of Hamar – a Shetland National Nature Reserve in its North Atlantic context.
N. F. Stewart & S. J. Leach. Fife's disappearing pondweeds.
N. F. Stewart & H. E. Stace. Interesting records from West Perthshire.

O. M. Stewart. (a) *Aira armoricana* Albers. (b) *Senecio squalidus* L. × *S. sylvaticus* L. on Arthur's Seat? (c) *Senecio* × *cardinensis* J. E. Lousley and *Vicia tetrasperma* (L.) Schreb. in v.c. 73. (d) Flower paintings.
H. S. Thompson. Works in process.
J. Tubbs. Flora by a photographic botanist.

In the lecture-hall, the following members gave short talks illustrated by colour slides:
P. J. Horton. B.S.B.I. visit to Hungary.
L. Farrell. Farrell's travels in Scotland.
J. D. Hooper. Some autumn flowers in Mallorca.
E. Milne-Redhead. A Black Poplar site of special biological interest.
P. F. Yeo. British *Euphrasia* species.
M. Jones. Coco-de-Mer, the world's largest seed.


Vice-counties
kms
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NAMES OF VICE-COUNTIES IN *WATSONIA*

ENGLAND, WALES AND SCOTLAND

1. W. Cornwall
1b. Scilly
2. E. Cornwall
3. S. Devon
4. N. Devon
5. S. Somerset
6. N. Somerset
7. N. Wilts.
8. S. Wilts.
9. Dorset
10. Wight
11. S. Hants.
12. N. Hants.
13. W. Sussex
14. E. Sussex
15. E. Kent
16. W. Kent
17. Surrey
18. S. Essex
19. N. Essex
20. Herts.
21. Middlesex
22. Berks.
23. Oxon
24. Bucks.
25. E. Suffolk
26. W. Suffolk
27. E. Norfolk
28. W. Norfolk
29. Cambs.
30. Beds.
31. Hunts.
32. Northants.
33. E. Gloucs.
34. W. Gloucs.
35. Mons.
36. Herefs.
37. Worcs.
38. Warks.
39. Staffs.
40. Salop
41. Glam.
42. Brecs.
43. Rads.
44. Carms.
45. Pembs.
46. Cards.
47. Monts.
48. Merioneth
49. Caerns.
50. Denbs.
51. Flints.
52. Anglesey
53. S. Lincs.
54. N. Lincs.
55. Leics.
55b. Rutland
56. Notts.
57. Derbys.
58. Cheshire
59. S. Lancs.
60. W. Lancs.
61. S.E. Yorks.
62. N.E. Yorks.
63. S.W. Yorks.
64. Mid-W. Yorks.
65. N.W. Yorks.
66. Co. Durham
67. S. Northumb.
68. Cheviot
69. Westmorland
69b. Furness
70. Cumberland
71. Man
72. Dumfriess.
73. Kirkcudbrights.
74. Wigtowns.
75. Ayrs.
76. Renfrews.
77. Lanarks.
78. Peebless.
79. Selkirks.
80. Roxburghs.
81. Berwicks.
82. E. Lothian
83. Midlothian
84. W. Lothian
85. Fife
86. Stirlings.
87. W. Perth
88. Mid Perth
89. E. Perth
90. Angus
91. Kincardines.
92. S. Aberdeen
93. N. Aberdeen
94. Banffs.
95. Moray
96. Easterness
96b. Nairns.
97. Westerness
98. Main Argyll
99. Dunbarton
100. Clyde Is.
101. Kintyre
102. S. Ebudes
103. Mid Ebudes
104. N. Ebudes
105. W. Ross
106. E. Ross
107. E. Sutherland
108. W. Sutherland
109. Caithness
110. Outer Hebrides
111. Orkney
112. Shetland

IRELAND

H1. S. Kerry
H2. N. Kerry
H3. W. Cork
H4. Mid Cork
H5. E. Cork
H6. Co. Waterford
H7. S. Tipperary
H8. Co. Limerick
H9. Co. Clare
H10. N. Tipperary
H11. Co. Kilkenny
H12. Co. Wexford
H13. Co. Carlow
H14. Laois
H15. S.E. Galway
H16. W. Galway
H17. N.E. Galway
H18. Offaly
H19. Co. Kildare
H20. Co. Wicklow
H21. Co. Dublin
H22. Meath
H23. Westmeath
H24. Co. Longford
H25. Co. Roscommon
H26. E. Mayo
H27. W. Mayo
H28. Co. Sligo
H29. Co. Leitrim
H30. Co. Cavan
H31. Co. Louth
H32. Co. Monaghan
H33. Fermanagh
H34. E. Donegal
H35. W. Donegal
H36. Tyrone
H37. Co. Armagh
H38. Co. Down
H39. Co. Antrim
H40. Co. Londonderry

B.S.B.I. Publications

Symposium Volumes

The following volumes arose from the very successful series of conferences sponsored by the Society. They contain authoritative papers on many aspects of British botany containing information which is not available elsewhere.

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   Ed. A. J. Wilmott, 1948. 104 pages, 18 plates. Wrappers. £4.25
2. THE STUDY OF THE DISTRIBUTION OF BRITISH PLANTS
   Ed. J. E. Lousley, 1951. 128 pages, illustrations and maps. £4.25
4. SPECIES STUDIES IN THE BRITISH FLORA
   Ed. J. E. Lousley, 1955. 189 pages, 2 plates and 23 text figs. £5.25
5. PROGRESS IN THE STUDY OF THE BRITISH FLORA
   Ed. J. E. Lousley, 1957, 128 pages, 4 plates and 9 text figs. £5.25
8. THE CONSERVATION OF THE BRITISH FLORA
   Ed. E. Milne-Redhead, 1963. 90 pages. £5.25
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   Ed. R. Vickery, 1984. 260 pages. Proceedings of a joint conference of BSBI and Folklore Society in 1983. £7.50
19. ARCHAEOLOGY AND THE FLORA OF THE BRITISH ISLES
   Ed. Martin Jones, 1986. Proceedings of a joint conference held in 1984.

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Presidential Address, 1986

D. E. ALLEN

PART ONE: ON BEING A HUNDRED AND FIFTY

Back in the early 1950s anyone who happened to work in the library of the Department of Botany at the British Museum would be startled every now and again by a fierce volley of expletives that emanated from somewhere on the upper floor. Traced to their source, these would be found to have come from a little, cross-looking, very old man bent over an array of open books and scraps of paper in what appeared at first sight to be a state of total confusion. He was a one-time member of the staff, long since retired, the more curious visitors would be gently informed, who was toiling away at a polyglot dictionary of botanical terms, which, alas, there was no likelihood of his completing before he was taken from this world. And that, sad to say, did in due course turn out to be the case.

The old man was a certain Antony Gepp, who in his time had done distinguished work as the Department's specialist in algology. And unless I am seriously mistaken, a Miss Branfill whose name features in the earliest list of members of our ancestor, the Botanical Society of London, was none other than his mother. A girl of sixteen then, she was to marry at twenty-nine, give birth to him when in her fortieth year – and leave him to live on until he was well into his nineties. Thus some of us here today have been privileged to touch hands, as it were, with the founders of the Society at just a single remove. A hundred and fifty years is not so long as all that: a couple of lifetimes only, at a rather extended stretch.

Yet in other ways 1836 does seem a very long time ago indeed. It was only two years before that that slavery had been abolished – and then only within the British Empire: other Western nations would continue to cling to it for a long time yet. At home meanwhile the penal laws were still horrific. Transportation remained in vogue. The gibbet had only just been abolished. It was only sixteen years since the last execution by beheading.

Politically, too, the scene was hardly a familiar one. William IV was on the throne and Melbourne was in the second year of what was proving to be an agonising premiership. After a period of acute unrest, of rick-burning in the countryside and rioting in the streets, the Reform Bill had eventually been passed, only to leave the radicals as noisy as ever, their appetites merely whetted. As they bayed at Melbourne's heels, the King and the House of Lords growled and snapped at him from above. Two years earlier, as if symbolically, Parliament had been in flames. Now the Prime Minister himself was the subject of a squalid trial, accused of adultery with a leading society beauty. The very next year the economy would collapse, a long depression would start and the Chartist agitation would set in. In another two years there would be a serious uprising in Wales and a chain of conspiracies in Yorkshire. It can hardly have seemed an auspicious time to be founding a national society.

Yet a much more familiar world was also just starting to appear. Already, six years earlier, the first passenger train service had been brought into being – and, soon after that, the first plant-spotting out of train windows. In June 1832, on a journey across Lancashire by this new form of travel, the young William Christy made several interesting records while moving, in his awestruck words, "at a speed which almost precluded any botanical observation" (Christy 1833). Within two years of the Society's founding the first excursion trains had even been introduced and Daniel Cooper, our founder, was leading a group of the members to "a spot . . . called Woking", chosen because it had become easy to reach by the newly-opened London and Southampton Railway (Cooper 1838). Only one year later Mr Bradshaw was to bring out the first of his national timetables.

It would be another four years yet, though, before the members would enjoy the penny post.

Even so, in the Society's inaugural year the crippling stamp duty on paper had been brought down to only a penny a sheet, one of the major spurts forward on the road to the abolition of the much-decried 'taxes on knowledge'. In that same year, too, the first provincial daily came out, and the University of London was established as a national degree-conferring institution. 1836 also witnessed, believe it or not, the first hospital training scheme, the earliest screw-driven steamboat and the foundation of the gas appliance industry. More ominously, the first fatal train derailment occurred, to be followed in the very next year by the earliest death from a parachute jump. Already, too, by 1835 Fox Talbot (a botanist, be it noted) had taken the earliest surviving photograph. Within four years of that even microphotography had been invented. A tremendous transformation in the everyday environment was in progress.

By comparison, science lagged. 1836 was the year of Darwin's return in the *Beagle*: over twenty more would have to elapse before the society in whose rooms we meet today would be the first to be told of its shocking outcome. 1836 was the year too in which Henslow held the last of his famous Friday evening 'at homes' for the science students at Cambridge. Now he was off to be a country vicar – and an absentee occupant of the Professorial Chair. The previous year the Royal College of Physicians had rescinded its rule that only graduates of Oxford and Cambridge could be elected as its Fellows, and the marvellous high summer which the sciences had enjoyed since the 1820s at those two universities as a result was abruptly brought to an end. Within a decade the number of medical students at Cambridge was down to a mere five or six yearly and empty classrooms were greeting the science professors to their embarrassment (Becher 1986). By 1846 Babington would be having to write: "Never was botany at so low an ebb as now in this place" (Babington 1897). At the embryonic London University the Chair of Natural History at King's had been abolished because of the shortage of students; and although the Chair of Botany there survived, the emolument that it carried was so disgracefully low that Edward Forbes would have to hold it in tandem with the Geological Society's Curatorship – which paid half as much again – in order to enjoy more than an artisan's existence (Wilson & Geikie 1861).

But if botany in English Academia was in sad disarray (and matters were very different up in Scotland, we must be careful to remember), it was a halcyon period for the subject elsewhere. Field botany, fashionable since the Linnaean 1770s, was now borne along on a second and much more massive wave, which penetrated far more sweepingly. Of its innumerable catches, almost every one was engaged in forming a personal herbarium, and wore on their roamings through the countryside that by now conventional emblem of the fraternity, the roomier, eighteen-inch students' vasculum (Allen 1959). Before long a member of that ancestral society of ours, Thomas Bentall, would have succeeded in interesting his family firm in producing a special drying-paper to accompany it.

Field botany was well into its great nineteenth-century expansion, brimming over with confidence, tingling with excitement. Additions to the flora were continuing to be turned up in the less well-worked corners of these islands at a not noticeably declining rate; and even if by then most of the more obvious and spectacular species had been discovered, keener discrimination seemed likely to ensure that the stream of novelties would not dry up for a long time yet. In that very year of 1836, indeed, there had again been an impressive haul: *Carex punctata* Gaud., *Cystopteris montana* (Lam.) Desv., *Calamagrostis stricta* (Timm) Koel. and *Spartina alterniflora* Lois. The previous one had yielded *Ononis reclinata* L., *Erica mackaiana* Bab. and *Valerianella carinata* Lois., the next would see the first of Babington's two successive forays to the Channel Isles and two more prizes as a result: *Ornithopus pinnatus* (Mill.) Druce and, most glittering of all, *Spiranthes aestivalis* (Poir.) Rich.

These were the years when the still-youthful Babington was busily making his mark, crisscrossing the British Isles one long summer after another and by his efforts alone considerably augmenting the total of species they were known to possess. Never to be a member of the Botanical Society of London (though he did join the later Botanical Exchange Club), he was twenty-seven when it was born. Watson, his resentful rival, and presently to be its mainstay, was five years older at thirty-two. Babington's *Manual*, the first really critical field handbook, was still nine years off; but Watson's *New Botanist's Guide*, that updated register of what each county held, was in the middle of coming out. Detailed treatments had appeared already of *Mentha, Salix* and *Rosa*; *Rubus* had been marginally nibbled; but *Hieracium* was still effectively virgin territory. It was obvious that there was a great deal waiting to be done.

AN ABNORMAL DEVELOPMENT

Having set the scene, I must now reluctantly drag you away from it. For if I continue, I can only recapitulate in brief what I have already set out at length in the book (Allen 1986) whose publication we are also celebrating this day. For that same reason this is debarred from being the kind of presidential address in which the president looks back down the road along which his society has travelled and points out the milestones. I know that view too well now, in any case, to be capable of describing it with an appetising freshness. I must leave you to discover it for yourselves under the guidance of the written page.

You will learn that the Society has been lucky to survive for as long as it has. There were two awkward junctures, indeed, at which its continuation was seriously in doubt. It has had to endure periods of autocracy and neglect, civil war, bankruptcy and the loss twice over of all its records. Only a body which met a very insistent need would have displayed such resilience.

All the same we must bear in mind that it has been a normal learned society for only just over a third of its life – that is, for fifteen years or so at its start and for the forty which have passed since the end of the Second World War. For much of the time in between it had a disembodied existence, so disembodied indeed that when the time came for Charles Bailey to lay down the Honorary Secretaryship in 1903 after twenty-four years, there was scarcely a single member who had met him in the flesh. Even after that period, during the years when that postal club grew steadily more accustomed to describing itself as a 'society', it existed as a physical entity more or less only through its annual reports. It never came together for lectures and not until latterly even for field meetings that were other than few, irregular and doubtfully official. Until the late 1940s there was not very much to be proud of – and a history chiefly notable for its heavy punctuation of rows and sniping.

So rather than give way to a *Schwärmerei* of self-congratulation of the kind so tediously traditional to commemorative occasions, it seems more in keeping to consider what the Society has missed. By its failure to enjoy an ordinary existence what has it been deprived of? What gaps in our activities are there still that might usefully be closed?

SOME DEPRIVATIONS

The most obvious of the deprivations is the lack of a library, a lecture-room, somewhere to call our own. Had the Botanical Society of London only continued, instead of dissolving and selling off all its possessions in 1857, there is every likelihood that we would now be in such richly-propertied circumstances as the Royal Entomological Society, a body which was founded only three years before us, took off from very much the same starting-point and in its infancy passed through some parallel vicissitudes.

From one point of view, of course, this is a deprivation that has turned into an advantage. All too many of the old-established metropolitan societies have found themselves under siege in recent years from spiralling wage bills and rocketing rents. In all too many cases now the marvellous collections of journal runs and books that they have accumulated through the years are distressingly little-used, largely duplicated as they have come to be by the libraries of the universities and of the major government institutions. Not a few societies, indeed, have found this inherited burden too heavy to sustain and have been forced, or at any rate have opted, to transfer it to some better-endowed pair of shoulders. Even so they have normally been able to arrange for their members to continue to have access, and can thus go on offering this valuable extra privilege to that limited proportion who enjoy no alternative facilities.

While we may have been spared an incubus, therefore, and along with it the expense of housing a staff, we have probably suffered a deprivation on balance. Certainly we have suffered one by having no place of our own in which to forgather before and after meetings of Council and committees. Since the sad demise of '*Domus Linnaei*', of hallowed memory, there has not even been a handy establishment 'just around the corner' to serve as the recognized assembly-point at which the formal business of the evening can be rehearsed or digested. Without a convivial warming-up beforehand, or a no less convivial winding-down afterwards, committee meetings tend to be too clinical and angular. Proceedings begin and end with an almost brusque abruptness;

newcomers are left at sea, unfamiliar with the background to the agenda (or with the identity of who they are sitting opposite or next to); the full inside of issues remains too thinly known. A society without an 'ante-chamber' life is a society without a valuable extra dimension.

Another by-product of having no premises is our lack of a programme of regular winter meetings. For if we were the possessors of a lecture-room of our own, we would surely wish to make use of it frequently. Certainly our ancestor could not have conceived of dispensing with such an activity: it was, after all, of the very essence of a metropolitan society of the kind it aspired to be. On the other hand since that ancestor of ours collapsed we have ceased to be metropolitan, albeit latterly London-based. This has left us without the metropolitan reflexes and so without the urge to restore the *status quo ante* and repair the deficiency. Had we those reflexes, we would surely long since have followed the example of, most notably, the London Natural History Society in not allowing the mere lack of facilities of our own to stand in the way of such a step.

But maybe we have done injury to ourselves by keeping to this non-metropolitan stance. Without a regular forum in which new findings can be critically debated as well as disclosed a scientific society is prone to a certain stunting. It is true that we have our symposia and conferences, but these are but occasional affairs and often on very restricted topics. It is true, too, that the conferences of Vice-county Recorders every other year give rise to ample and sometimes vigorous debate; but, again, these are specialized in their focus and in any case cater for only a limited section of the membership. There is no outlet for papers on non-prescribed topics, for the reporting of work that is still at an early stage, for the airing of general critiques or the mere floating of ideas. And because we do not have one, it has regularly fallen to the Linnean Society, instead of to ourselves, to play host to those one-day gatherings of doctoral students who have theses in train on the biosystematics of British vascular plants. It is excellent that such occasions should occur and excellent that a national society should sponsor them; but it would surely be even better if those engaged in these studies had an opportunity to outline their investigations to an audience that is best placed of all to assist with material, observations and records from all over the British Isles.

Filling this gap need not mean the instituting of a full-scale winter programme. It is doubtful if the supply of suitable material would warrant that in any case; moreover, there are a sizeable number of botanical topics on offer from other societies with just such programmes already. But even just one or two meetings might help to brighten the dark nights and make the annual Exhibition less of an oasis in that long, bleak desert between the end of one plant-hunting season and the opening of another.

There is one further deprivation which I suspect it may not even have occurred to the Society that it suffers. It arises from the fact that we confine ourselves to the flora of the British Isles – just as we do to only certain sections of that flora and to only certain aspects of its study (though it is not with those other limitations that I am here concerned). Had only the Botanical Society of London managed to carry on, the whole of the world – and, for that matter, the whole of the science of botany – might still be our oyster, on the pattern of the metropolitan societies in general. When it folded, the field of vision contracted abruptly to that of its surviving rump of members: a handful of collectors, of very modest means, mostly out in the provinces, whose private herbaria were restricted, more or less of necessity, to the flora of these islands and, by choice, to their vascular plants alone. That new cement set hard, so hard in fact that it has remained in place ever since. And who is to say whether the Society would have done any better had it taken a less insular course?

All the same we should recognize that in settling upon these particular geographical bounds, indeed by putting ourselves in thrall more generally to taxonomy's 'territorial imperative', we have settled our fate in a wider and subtler way. For because there are, unfortunately, so relatively few taxa that the flora of these islands shares with the flora of Canada and the United States, we have deprived ourselves of any chance of participating in what has been termed "the common culture of the North Atlantic triangle" (Berger 1982). In almost every other field of scholarship this English-speaking triangle houses what amounts to a single community, a community in which a specialist based in Britain is as likely to find his closest kindred spirits in Berkeley or Toronto as in Glasgow or Leicester. From both sides of the Atlantic contributors subscribe to, and write for, shared journals; there are frequent transatlantic conferences and symposia; libraries and archives in the British Isles are thick for large stretches of the year with researchers from North America. The social interpenetration is as wide as it is deep and a source of great enrichment, personally as well as intellectually, for those with the good fortune to be able to partake of it. Alas, though, by the nature of the course we have taken, it can never be for us. All that we can do is to eye it with eternal envy and regret what we have had to miss.

So much for the shortfalls in our ways of functioning that we happen to suffer from by virtue of the particular kind of society that we are. There is little enough that we can do about them, but I have pointed to ways in which that little might be done.

PART TWO: WORK ON INFRASPECIFIC VARIATION

But what about the scientific content of our work? Are there any glaring gaps in that still waiting to be filled? This is something that we shall be discussing this afternoon and I must be careful therefore not to encroach on the area overmuch. There is one suggestion, however, that I would like to put forward which I feel fairly confident no one else plans to propose at that later juncture. It amounts to taking up where one of my predecessors in this office, Professor Valentine, in effect left off in the stimulating Address that he delivered on this same occasion eight years ago. In the course of a wide-ranging review of experimental work on the British flora he remarked upon the fact that "interest in variation below the level of the species and in the naming of taxa at the level of variety and form has tended to decrease in the writing of local Floras" (Valentine 1979a). This is indeed only too true. Someone picking up and leafing through the average local Flora published in recent years might well suppose himself back in the era of the fixity of species, so largely absent is any hint that the entities listed are subject to variation – and to variation that at least in the past has come in for taxonomic recognition.

The reason for the silence, of course, is that writers of local Floras tend to take their cue from the national Floras currently in use, and the national Floras have yet to grow out of the general revulsion between the Wars against the excess to which the earlier 'stamp-collecting' school had taken the naming of minor variants. The experimental studies which came into fashion in the 1930s showed that some of these taxa were quite without substance, reverting to normal when tested in cultivation, while others were no more worthy of a name than many analogous variants that had merely happened to escape notice. More basically, they also showed that the variation in many species is so complicated or so extensive that it is hardly feasible to attempt to do justice to it taxonomically. In any case the established hierarchy of categories – subspecies, variety and form – had come to seem artificially restrictive, even supposing that any broad measure of agreement could be reached on how they were interpreted.

Unnerved by the strictures of the new experimentalists, Flora-writers responded by dropping more or less all mention of infraspecific variants from their pages, doing so indeed with considerable relief, for they secured as a result a less cluttered text and useful savings in space. Left without names and descriptions, recorders in the field in their turn gradually lost the habit of noting the variants that they met with. The widespread use of mapping cards with room only for the names of species (and only for a proportion of those) has merely intensified the trend.

It is a trend, though, that has surely now been allowed to go much too far. The study of micro-evolution is no less important than ever it was and it is a study in which field botanists ought to be contributing their due. For despite the salutary correctives to past simple-mindedness administered by the genecologists and their like, there is in fact a great deal of value that could still be contributed by straightforward observation. Many of the taxa lodged in the past literature have too readily come to be dismissed as no longer worth recording merely because they are based on a departure from the norm in just a single character. Yet it does not need much searching through the older Floras and back numbers of journals to turn up evidence that differences even as slight as this are by no means without interest in the pattern of their occurrence geographically. Thanks to the fact that many of the ablest and most assiduous field botanists of the second half of the nineteenth century were marooned in isolated country parishes or confined to the area they could cover in the course of a Sunday ramble on foot, their explorations tended to become ever more minutely intensive and the many described minor variants, no less than the microspecies, were the beneficiaries of this. There was a rich harvest as a result, which has still been only very partly cut.

There is a form of *Medicago lupulina* L., for example, in which the pods are tubercled instead of smooth. S. F. Gray christened it var. *scabra* as early as 1822. According to workers in the period around the turn of this century this is the prevailing form of the species round Malvern, in Herefordshire and Worcestershire (Towndrow 1911), whereas in Oxfordshire it is scarce (Druce 1890) and in Derbyshire even scarcer (Drabble & Drabble 1911). Should that pattern prove to be confirmed, it is odd enough to need explaining. Similarly there is a form of *Filipendula ulmaria* (L.) Maxim. in which the normal tomentum is missing on the under-surface of the leaves. The character is known to breed true (Druce 1911) and to remain unaltered by differential cultivation (Beeby 1888; Yapp 1912). Yet again, oddly, while rare in some districts it is the prevailing version of the species in others. If we are to believe the old records, a puzzling alternation of this kind is also displayed by the variant of *Leontodon taraxacoides* (Vill.) Mérat with a hairy involucre.

Rarely in such cases have any ecological differences been reported that might provide a clue to the selective factors at work – always assuming there are any and that the patterns are not merely random. One exception is the claim by Druce (1897) that the form of *Polygonum convolvulus* L. which has the calyx segments winged, var. *subalatum* Lej. & Court., is the representative of that species in rich garden ground, bushy places and hedges, while the 'normal' form is characteristic of cornfields. That observation, however, seems hard to square with the finding by Drabble & Long (1932) that the variant is the commoner of the two by far in the Isle of Wight. It may be, though, that *Polygonum convolvulus* is one of those species in which the native, or at least old-established, populations are conveniently distinct in some external way from more recently-arrived ones or from mere casual specimens. Examples of this are to be found in *Papaver rhoeas* L., *Sisymbrium officinale* (L.) Scop., *Silene vulgaris* (Moench) Garcke, *Lapsana communis* L. and *Cirsium arvense* (L.) Scop., in each of which the plants prevailing in more southerly parts of Europe differ in one way or another in their hairiness. Even more conveniently, populations from further south or east in Europe may have different flower colours: in *Raphanus raphanistrum* L., for example, purple as opposed to yellow or white, in *Anagallis arvensis* L. blue as opposed to scarlet. One of the strongest reasons for studying infraspecific variation, it has always seemed to me, is that it can so often help in clarifying status. Indeed it is only thanks to enthusiasts for this line of work, and to the taxonomic trail that they have left behind them, that we know of seemingly native ecotypes of species that otherwise tend to be dismissed as non-indigenous: the condensed, *Erophila*-like form of *Arabidopsis thaliana* (L.) Heynh., for instance, on rocks high up in the central Pennines for which Druce (1924) coined the epithet *brevicaulis*, or the prostrate plants of *Spergula arvensis* L. in short close turf in the Channel Isles which E. F. Linton (1907) first brought to notice and described as var. *nana*.

Spergula arvensis, as it happens, has also been the subject of a model study in recent years (New 1958, 1959) in which the nature of the two main ways in which that species has long been known to vary has now been definitively elucidated. In one of these variants, known as var. *sativa* (Boenn.) Mert. & Koch, the seed-coat lacks the usual papillae; in the other the plant as a whole is densely hairy. It turns out that, although there is no link between the two genetically, both exhibit much of the same geographical trend, increasing proportionately from south-south-east to north-north-west and with increasing altitude, not only within the British Isles but across Europe more generally. It would seem logical to infer from this that both characters are adaptations to a climate combining a greater coldness with a greater wetness, and experiments have indeed shown that the plants with non-papillose seed-coats do germinate more readily at low temperatures.

Many other variants probably occur with increasing frequency in a particular direction like this, in response to a gradual *crescendo* in the environmental tendency that favours them. In some cases the variation takes the form of a more or less steady shift in the proportion of one character at the expense of another sharply contrasting with it – a polymorph-ratio cline in the technical terminology. An example is the gradual outnumbering north-westwards across Europe of blue-flowered *Anagallis arvensis* by the scarlet type. Typically, as in this case, just a single pair of genes is involved; but sometimes the situation is more complex. In *Raphanus raphanistrum* there are four different colour forms, purple, white, pale yellow and deep yellow, which replace one another across Europe in a series of broad but widely overlapping belts. In the south of Britain the white and pale yellow forms commonly grow intermingled and there discrimination between these by insect pollinators has recently been discovered to be extremely marked (Kay 1976). Presumably in this case the influence of climate is at one remove.

After flower colour, in which frequency differences are so much more obvious, the most numerous reported examples of ratio clines seem to be in leaf-marking. The best-known of these is the north-south one in *Arum maculatum* L., the populations of which in the north and west of the British Isles have unspotted leaves almost exclusively (Prime 1955), although even as far south as Wiltshire spotted plants constitute no more than a fifth of the total (Grose 1957). By contrast, in *Dactylorhiza praetermissa* (Druce) Sóo the cline is an east-west one, with a lowering in the incidence of leaf-marking across southern England as one travels towards Kent (Heslop-Harrison 1958). Another east-west example, this time in a fruit character, would appear to occur in *Stellaria neglecta* Weihe; for according to Marshall (1914) the form of that with the seeds bluntly instead of acutely tubercled, his var. *decipiens*, is scarce in Somerset but easily predominates in Sussex and Surrey.

We do not know what degree of stability these ratio clines possess, for no measuring of populations has yet taken place over a sufficiently lengthy period. Certainly in butterflies short-term fluctuations of a sometimes startling magnitude have been reported. That they may occur in flowering plants as well might appear to be indicated by the marked increase that has taken place in recent years in the rayless form of *Aster tripolium* L. (var. *discoideus* Reichb.) on many East Coast salt-marshes, at the expense of the normal rayed one. Gray (1966) has proved statistically that the rayless plants are more characteristic of the lower zones of the marshes and believes their greater ability to withstand tidal submergence gives them a selective advantage there. The spread of *Spartina* may have been responsible for changes in the ecology which have provided the necessary opening. On the other hand it seems that there is more than just raylessness to this taxon: according to another author (Burtt 1970) it also has a different habit, thicker and more brittle leaves and a shorter pappus. So it is perhaps better classed as an ecotype than as the kind of single-character variant typical of ratio clines.

But not all clinal variation involves clear-cut entities of the sort just described. Very often the graduated response to a graduated environmental influence is expressed developmentally, in stature, say, or leaf shape; and because the genes controlling growth tend to be more numerous and their interaction complex, the variation in that takes the form of a continuous dimensional trend in a particular character or character-cluster. In these cases simple percentage counts are clearly out: measurements have to be made and biometrics grappled with. For that reason the record of the earlier botanists in discriminating such variation is less impressive. In many species indeed they overlooked its existence entirely, simply because of the very gradualness of the changes in appearance. Alternatively, they dismissed it as of no taxonomic worth, with the standard verdict of 'grades into type'. When they did give it recognition, the solution adopted depended on how narrowly or widely the variation ranged. If it was sufficiently narrow, as in the east-west cline in the length of the outer calyx teeth in *Lythrum portula* (L.) D. A. Webb (Druce 1911; Allen 1954b), it was feasible not only to give a varietal name to what was regarded as the extreme (that is, the furthest the character departed in shape or size from whatever was taken to be the norm), but also to capture the whole of the variation in between with a single 'omnibus' varietal name as well. If the variation was much wider, however, as in the leaf-cutting of *Anthriscus sylvestris* (L.) Hoffm. (Druce 1917), no one name could be made to do service for so long a bridge of intermediates and, rather than coin a whole series of names for these, just the two extremes were treated to taxonomic recognition. The futility of doing anything more than this was well illustrated by a study made in Denmark and part of Sweden of the extent of the variation that needed to be accounted for in that same species: it transpired that a total of sixteen different taxa would have had to be created if the taxonomic potential had been pursued to its logical conclusion (Petersen 1915). In a similar study of the leaf-cutting in *Pimpinella saxifraga* L. the artificiality of the practice of giving a name, in this case the so-called 'var. *dissecta* (Retz.) Spreng.', to merely one part of what was shown to be a continuum was reasonably called into question (Petersen 1921). But just how such variation is to be handled taxonomically, if indeed it *can* be accommodated within the established system at all, is something that still remains unresolved.

A clear distinction is often not easy to make out, at any rate from the literature, between truly continuous geographical trends and cases where a variant merely becomes more common in a particular climatic region. For example, is the form of *Sagina subulata* (Sw.) C. Presl without the usual glandular pubescence, var. *glabrata* Gillot, mainly in the north and west of the British Isles (Harrold 1978) as one end of a ratio cline – as the golden yellow form of *Melampyrum pratense* L., var. *hians* Druce, so clearly is – or is it a mutant which has been able to colonize those parts thanks to a selective advantage there but scarcely to penetrate the more southern and eastern populations of the species? Exactly the same question has to be asked of the form of *Angelica sylvestris* L. with the upper leaf segments more or less decurrent, var. *decurrens* Fisch., Mey. & Lallem., which is said to prevail in the north and west similarly (N. D. Simpson, pers. comm. 1951). On the other hand it is hard to see why the form of *Gnaphalium uliginosum* L. with hairy fruits, var. *pseudopilulare* Scholtz, should apparently be commoner than the glabrous-fruited form in France (Corbière 1894; Hariot 1895) whereas the paucity of records appears to suggest that the opposite is the case on this side of the Channel. Under-recording is the stumbling-block at present in seeking to interpret such patterns.

All the same some variants are so conspicuous that it is hard to believe that their distribution is not known with tolerable completeness. My favourite in this connection is the colour form of *Iris foetidissima* L. in which the normal livid purple is replaced by clear lemon yellow with merely purple lines. It was named var. *citrina* by Bromfield early last century. There is a strong concentration of it in eastern Dorset, in Purbeck, where five localities had been discovered by 1895. It has also been recorded from two places in the Isle of Wight, from one in central Dorset and from near Newton Abbot in Devon; a single plant was also found near Bath in 1924. Though scattered over quite a wide stretch of country, the finds are sufficiently centred on Purbeck to suggest very strongly that that is where this mutant arose. It is a great pity it escaped being mapped in the *Critical Supplement to the Atlas* (Perring & Sell 1968).

Hardly less conspicuous is the form of *Bidens cernua* L. with ray florets, var. *radiata* (Roth) Lindl. Of this there is a similar clustering of records, this time in Cheshire and South Lancashire; but it has also long been known in a locality in as far from there as Somerset, so in this case independent mutations, perhaps on many occasions (for the variant is known on the Continent), seem likely. The same may be true of the rich magnolia purple form of *Trifolium repens* L., var. *rubescens* Sér., so prevalent in Scilly but also (McClintock 1975) in several places in Guernsey.

Variants less obvious than these, however, must be presumed to have been at best only patchily recorded. Only when there has been cause for a species to be investigated intensively, as in the accounts prepared for the *Biological Flora of the British Isles*, have there been exceptions. It is only thanks to the unusually thorough study carried out for that work by Lewin (1948) of the variation of the species of *Sonchus* that we know that there is a form of *Sonchus asper* (L.) Hill with white achenes which is common in the Orkneys and on the north and west Scottish mainland. It is apparently without a name. Many may think, indeed, that variants as slight as this, probably the product of just a single gene, are too trivial to warrant lumbering the literature with yet further taxa. On the other hand if they are left unnamed, they are likely to go unrecorded (unless they should happen to be the subject of someone's special interest) and the surely not unimportant fact that they have achieved a distinctive, reasonably compact range may consequently be overlooked. It is not unimportant, of course, for the reason that any mutant capable of carving out a range for itself must be presumed to have some selective influence in its favour and may thus be an incipient local race, perhaps in the course of time to accumulate a further measure of distinctiveness sufficient to entitle it to subspecific rank. Just such a process seems to be in the course of happening in the case of the suberect ecotype of *Anagallis arvensis* which occurs mainly on sand dunes in the west of Britain and Ireland. Some of the populations of that, but by no means all, have acquired the additional distinction of flesh-coloured flowers – the so-called var. *carnea* (Schrank) Boenn. (Rilstone 1938; Allen 1954a). The similarly western coastal race of *Calystegia sepium* (L.) R.Br., subsp. *roseata* Brummitt, is one step further on: as well as its rosy corolla it has more acute leaf tips and more pubescent stems (Brummitt 1967).

That brings me to the vexed question of how the three infraspecific categories acceptable under the international rules are most appropriately interpreted. Clearly, hard-and-fast dividing-lines are not to be expected, as we have learned not to expect them between subspecies and species. At the same time it is surely not utopian to look for a reasonable measure of consensus about which level in the hierarchy of taxonomy is appropriate to which level of the hierarchy observable in nature. Until the 1930s we seemed to be making good progress in that direction. Then along came genecology and the advocating of alternative courses. The more extreme of these was the abandonment of the traditional terminology in favour of an entirely new one freed from the shackles of taxonomy altogether. That 'deme' concept, however, despite the appeal of its goodstrain versatility, seems to have proved but a passing vogue. The other course was the compromise one of taking one of the traditional categories and fashioning it anew. The chosen victim was the subspecies. The term 'variety', it was held, had become too irretrievably ambiguous to be usable any longer – and any variation below that level was too trivial to be worth bothering with. But whereas a subspecies had previously been thought of as more or less synonymous with a geographical race, the genecologists took the view that no sustainable distinction could be drawn between the subdivisions of a species created by lengthy isolation or adaptation to a different climatic zone and those subdivisions, typically much smaller and much more restricted in their occurrence, which result from adaptation to particular specialized habitats ('ecotypes', as they have come to be known). This was despite the fact that these latter are, by their very nature, capable of arising independently in more than one place and are thus the very antithesis of what plant geographers have been accustomed to think of subspecies as denoting – namely, broken-off bits of a species which, by virtue of their uniqueness, can serve as valuable historical evidence. An essential part of the coinage, in other words, was damagingly debased. The subspecies became "the dumping ground for many sorts of situations", used for the accommodating of entities as disparate as cryptic or semi-cryptic polyploids, maritime or alpine ecotypes, physiological races and other morphs differing in relatively minor characteristics – in addition to the traditional geographical races (Stace 1976).

This broadening of the subspecies has introduced a further layer of confusion into what was already a more than sufficiently confused state of affairs. What is more, followers of this approach who have made revisionary incursions into our flora in the post-war years have tended to leave behind them an irritating lopsidedness. In the Shetlands, for example, the dwarf ecotype there of *Silene dioica* (L.) Clairv. has been raised to subspecific rank (Baker 1947, 1948) – maybe rightly, in view of its distinctiveness geographically as well – but the no less distinctive race of *Senecio aquaticus* Hill that occurs in such profusion in those islands remains unpromoted from the varietal level at which Druce (1921) described it. More seriously, the heritable forms of *Geranium robertianum* L. that occur on shingle round our coasts have been grouped all together, though according to Yeo (1973: 339) quite unjustifiably, and elevated similarly to a subspecies (Baker 1956) – receiving as a result, ironically, their proper due at last from recorders – but, again, the analogous versions of *Galium aparine* L. and *Solanum dulcamara* L. have been allowed to languish in mere varietal obscurity in contrast. The same goes for the 'cushion' ecotypes of maritime habitats that have been described in a number of species: alone among these that of *Valerianella locusta* (L.) Betcke has been dignified with the higher rank (Sell 1967).

On top of this inconsistency – or rather, lurking beneath it – there is a terrible chaos in the nomenclature. Continental names have long been taken over for similar-sounding British variants without any comparison of specimens, let alone consulting of type material; there has been no thorough searching of even the British literature to check whether earlier valid names exist; descriptions are very often inadequate. Yet better wrong names than no names at all, surely: we should not allow such problems to serve as an excuse for total inaction. For I hope I have said enough by now to have convinced you that there is a major gap here in our knowledge of the flora of these islands, which it is high time that this Society led the way in seeking to close.

An essential preliminary, though, is for us to know what has been discovered already. As I have attempted to demonstrate, there is a vast store of data on the subject buried in the past literature: what we require in the immediate instance, and urgently, is a compendium bringing it all between two covers. When Professor Valentine addressed you on this same topic in 1979, he spoke in the knowledge that the projected five-volume 'Flora of Great Britain and Ireland' would be taking care of that deficiency (Valentine 1979b). Since then, alas, that project has foundered, and the Society now remains the only hope. But it has successfully produced already a bible on British hybrids (Stace 1975): I see no reason why it cannot follow suit now with a companion volume on British infraspecific variation.

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Variation in *Jasione montana* L. (Campanulaceae) and related species in Europe and North Africa

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ABSTRACT

This paper describes the variation of European and North African *Jasione montana* L. North African material is assigned to *J. montana* subsp. *cornuta* Greuter & Burdet. All other *J. montana* belongs to *J. montana* subsp. *montana* within which six varieties are recognized. These are *J. montana* subsp. *montana* var. *montana*, *J. montana* subsp. *montana* var. *litoralis* Fr., *J. montana* subsp. *montana* var. *latifolia* Pugsl., *J. montana* subsp. *montana* var. *echinata* Boiss. & Reuter, *J. montana* subsp. *montana* var. *bracteosa* Willk. and **J. montana** subsp. **montana** var. **imbricans** J. Parnell, **var. nov.** Only the first three of these varieties occur in Britain. A number of *Jasione* species are relegated to synonymy with these taxa though the closely related *J. penicillata* Boiss., *J. corymbosa* Poiret ex Schultes and *J. heldreichii* Boiss. & Orph. are maintained as species. The two latter species are each recognized as containing two varieties; these are *J. corymbosa* var. *corymbosa*, **J. corymbosa** var. **glabra** (Durieu ex Boiss. & Reuter) J. Parnell, **stat. et comb. nov.**, *J. heldreichii* var. *heldreichii* and **J. heldreichii** var. **papillosa** J. Parnell, **var. nov.**

INTRODUCTION

The genus *Jasione* L. (Campanulaceae) contains twelve species. It can be conveniently split into an annual/biennial section and a perennial section. Although two of the perennial members, *Jasione bulgarica* Stoj. & Stefanov and *Jasione foliosa* Cav., have, on occasion, been placed in separate genera, I feel that *Jasione* clearly forms a single natural entity. In this paper I have applied a combination of a detailed, experimental, biometric study of *Jasione montana* L. from the British Isles and herbarium observations of material from elsewhere to re-assess the infraspecific classification and relationship of all non-perennial *Jasione* species.

J. montana is the most widespread species in the genus, occurs commonly throughout Europe, and has an ill-defined pattern of infraspecific variation. Details of its autecology, morphology and distribution are given in Parnell (1985). Plants of this species may be either annual or biennial, may vary from almost glabrous to hirsute, may be branched in the lower half or unbranched and be from 1 to 65 cm tall. Recent revisions vary considerably in their treatment of this infraspecific variation. In a continuing series of papers, Rivas-Martinez (1967, 1976, 1979) and Greuter (1981) recognize a number of subspecies of *J. montana*, whereas Tutin (1976) recognizes none.

The only complete revision of *Jasione* is that of Schmeja (1931) but his work has, with good reason, been laid aside and it is the earlier work of Pugsley (1921) which most clearly outlines the current understanding of British Isles *J. montana*. Pugsley (1921) distinguished five, rather ill-defined, varieties; these are a decumbent sand-dune taxon *J. montana* var. *litoralis* Fr., a gross cliff-top taxon *J. montana* var. *latifolia*, a dwarf cliff-top taxon *J. montana* var. *maritima* Bréb., a glabrous variant *J. montana* var. *laevis* Duby and a tall variant *J. montana* var. *major* Mert. & Koch. The major problems with these taxa are that Pugsley's own annotated specimens (**BM**) do not correspond with his descriptions and that they were described in the absence of information on phenotypic variation in *J. montana*. Additionally, continental workers have described many largely undistinguished taxa, which may or may not occur in the British Isles.

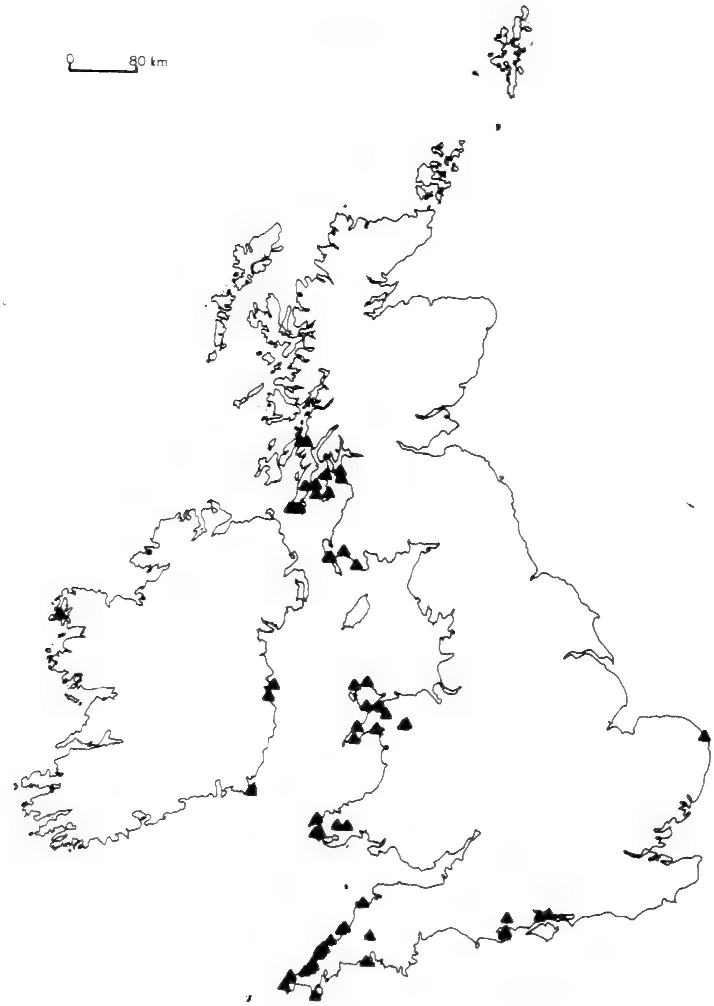

FIGURE 1. The location of populations sampled for morphological analysis.

VARIATION IN *J. MONTANA* WITHIN THE BRITISH ISLES

SAMPLING, SCORING, CHARACTER SELECTION AND PRELIMINARY ANALYSIS

A total of 59 populations from a wide geographical and ecological range were sampled during the summers of 1977 and 1978. Fig. 1 shows their general location; grid references are given in Parnell (1980).

At each site 25 flowering specimens were collected at random, pressed and taken back to the laboratory for measurement. At some localities, seeds from another 25 randomly selected individuals were collected. These were sown individually in potting compost in 10-cm flower-pots and grown to maturity in a cold frame. Representative specimens of the wild populations are deposited in **ABD** and/or **TCD**. No population of less than 100 individuals was sampled.

39 morphological measurements, including four derived ratios, were made on all Scottish populations. Of these 39 measurements, 20 proved redundant due either to high correlation with another measurement or lack of variation and it was found that the remaining 19 adequately described a plant's morphology. These are listed in Table 1 and some are illustrated in Fig. 2.

TABLE 1. CHARACTERS USED IN THE ANALYSIS OF BRITISH ISLES *JASIONE MONTANA*

1. Plant height, measured from the base of the leaf-rosette to the top of the plant
2. Plant width, the widest diameter of the leaf-rosette or the total spread of any decumbent stems
3. Leaf length, measured on the fourth leaf down from the top of the main peduncle, is taken along the midrib from the base
4. Leaf breadth (the maximum breadth of the same leaf used in 3)
5. The maximum diameter of the peduncle, taken from just under the involucral bracts (Fig. 2, No. 5)
6. The maximum diameter of the largest flowering head (Fig. 2, No. 6)
7. The maximum diameter of the involucre (Fig. 2, No. 7)
8. The maximum length of the outermost involucral bract, from the base to its widest point (Fig. 2, No. 8)
9. The maximum length of the pedicel (Fig. 2, No. 9)
10. The maximum length of the calyx (Fig. 2, No. 10)
11. The maximum width of the calyx-teeth (Fig. 2, No. 11)
12. The number of flowers in the terminal inflorescence
13. The number of flowering stems
14. The ratio of plant height to width
15. The ratio of leaf length to breadth
16. The ratio of involucre to inflorescence diameter
17. The hairiness of the hypanthium. Recorded as present or absent
18. The hairiness of the plant. Recorded on a 0–5 subjective scale with 0=No hairs, 1=very few scattered hairs, 2=sparsely hairy, 3=moderately hairy, 4=hairy, 5=very hairy
19. The habit of the plant. Recorded as either decumbent or upright

Three characters, numbers 2, 12 and 13 (Table 1) were found to be non-normally distributed. These data were normalized using either a square root or a Log_{10} transformation. The transformed values were used in all further calculations. Three other characters, numbers 17, 18 and 19, were not measured on a continuous scale and were therefore not used in the multivariate analysis.

The size and shape of the involucral bracts has been a commonly used diagnostic feature both of British varieties and continental subspecies of *J. montana* and also of other *Jasione* species. However, analysis indicated that involucral bracts showed considerable variation in size, shape, toothing and colour both within a single plant and also between plants within a single population. The bracts illustrated in Fig. 3 are all taken from the main inflorescence of four adjacent individuals from a single Irish population of *J. montana*. Small variations in bract characters are, therefore, unlikely to be of taxonomic importance though large differences in the outer involucral bracts, e.g. ovate vs lanceolate, may still be of use.

Preliminary analysis also showed that there was continuous variation in height and leaf dimensions between and within populations. Therefore plants formally distinguished as *J. montana* var. *major* Mert. & Koch (mostly on the basis of their large size (Pugsley 1921)) do not warrant recognition. Equally, dwarf plants formally distinguished as *J. montana* var. *maritima* Bréb. (Pugsley 1921) were mostly found to occur intermingled with plants of larger size. A single population (C10) consisting entirely of dwarf plants and only separable on size characteristics from *J. montana* var. *montana* was found. Continuous variation also occurred in the density of the indumentum between plants within a population, some being almost glabrous whilst others were hirsute.

NUMERICAL ANALYSIS OF POPULATIONS

The main numerical analysis was carried out on 1025 plants representing 41 of the 59 sampled populations. Additional analysis, using means of population characters, was carried out on the 32 populations of *J. montana* sensu stricto.

I used two fundamentally different multivariate techniques to analyse the data. The first, Principal Components Analysis (PCA), I used to examine patterns of variation or groupings of plants present in both meaned and raw data. Technically, PCA aims to produce axes which summarize the raw data and against which combinations of plants or other entities can be plotted. Its interpretation is often difficult because simple biaxial plots, which are the type most often used, are limited views of any variation pattern, and their interpretation depends on the percentage of the variance accounted for by each axis. The programme used was BMDP4M (Frane & Jennrich

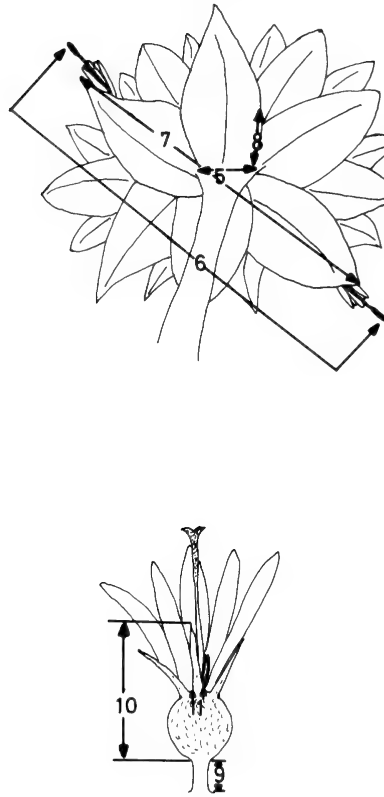

FIGURE 2. Morphological measurements made on the flowers and inflorescences of *J. montana*. The numbers refer to the corresponding characters described in Table 1.

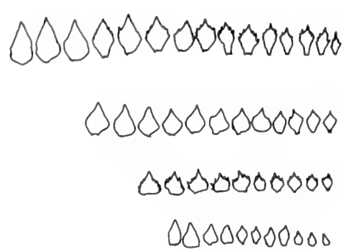

FIGURE 3. Bract outlines, from the outermost (left-hand) to the innermost (right-hand) bract, for four adjacent individuals from a single population of *J. montana* at Carnsore point, Ireland (GR 31/12.04).

1977). The second technique, Discriminant Analysis (DSC), was used to test whether groups of individuals assigned to different varieties of *J. montana* could be separated on the basis of a particular set of morphological characters. It was also used to determine if populations retained their distinctive characters (i.e. group membership) on cultivation. DSC allows any change in morphology to be reflected as a change in group membership. Technically DSC can, as Marriot (1974) states, be thought of as a multivariate extension of analysis of variance. The computer analysis used was published in the SPSS series (Nie *et al.* 1975).

In addition to the multivariate statistics used, mean values and confidence limits were calculated for each of the characters measured. These univariate statistics were used to quantify and express differences in the morphology of the groups seen on PCA and discriminated by DSC.

RESULTS OF PCA, BASED ON ANALYSIS OF INDIVIDUAL PLANTS

Altogether, 16 axes were required to explain fully all the variance in the sample. Marriot (1974) points out that axes with eigenvalues less than unity account for less of the variance than a single individual variable and do not therefore represent a condensation of the data and should not be plotted. In this analysis only four eigenvalues had values greater than unity and only three substantially so. Axes one, two and three accounted for 40%, 12% and 10% of the total variance respectively. Axes one and two are plotted in Fig. 4.

Membership of previously accepted groups is indicated on the PCA plot (Fig. 4). The groups are defined partly on groupings noted in the field and partly on the basis of previous descriptions. The groups used were:

1. *J. montana* var. *litoralis* Fr., defined on the basis of its decumbent habit, short stature (<20 cm), small lanceolate leaves (0.5–1×0.2 cm) with unthickened margins, and involucral bracts which are rhomboidal, acute or obtuse and sub-entire and which do not exceed the inflorescence;
2. *J. montana* var. *latifolia* Pugsley, of upright habit, 10–30 cm tall and distinguished by its large sub-spathulate leaves (1–2.5×0.4–0.9 cm) which often have thickened margins, and its involucral bracts which are broadly ovate, acute or obtuse with obscure teeth and which exceed the inflorescence;
3. *J. montana* var. *montana*, containing all other plants of *J. montana*.

In Fig. 4, those plants which showed maximum overlap between the varieties, thereby emphasising any overlap between groups, have been plotted. Despite this, it is evident that Fig. 4 offers at least moderate support for there being a separation between the varieties recognized.

RESULTS OF PCA, BASED ON ANALYSIS OF POPULATIONS OF *J. MONTANA* VAR. *MONTANA*

PCA of *J. montana* var. *montana* populations (Fig. 5) showed that there are morphological differences between populations of this variety from different parts of Britain. For example, plants from Scotland tend to have more flower stalks, smaller bracts and to be taller in relation to their basal spread than plants from the rest of the country. Some individual morphological characteristics also showed variation between different geographical regions, e.g. more than 55% of flowers of plants from Cornwall, Devon and Dorset had a glabrous hypanthium, decreasing to 38% from south Wales and only 18% of those from north Wales and southern Scotland. Such differences are relatively minor in comparison to those that exist between the different varieties of *J. montana* detailed above and seem to be largely eliminated on cultivation under standard environmental conditions, but they are evident in herbarium collections.

RESULTS OF DSC, BASED ON ANALYSIS OF INDIVIDUAL PLANTS

An objective measure of the separation between the groups recognized in the PCA of individual plants was obtained by discriminant analysis. Two significant discriminant axes were extracted. The first and second discriminant functions respectively accounted for 67% and 33% of the total variance, were highly significant (χ^2=1519, $p<0.01$ and χ^2=569, $p<0.01$) and therefore gave a good summary of group differences. The F-values obtained for differences between the groups were all highly significant at $p<0.01$ (i.e. between *J. montana* var. *montana* and *J. montana* var. *latifolia*, between *J. montana* var. *montana* and *J. montana* var. *litoralis*, and between *J. montana* var. *litoralis* and *J. montana* var. *latifolia*). Thus the groups tentatively identified on PCA are very different from each other.

Fig. 6 shows the mean values for each character, together with the 99.9% confidence limits for all characters measured for all three varieties. The most important difference between *J. montana* var. *latifolia* plants and those of the other two varieties lies in the possession of bracts which are significantly longer to their widest point (Fig. 6A), in the larger size of the inflorescence and diameter of the peduncle (Fig. 6B, 6C & 6D), in their taller, narrower growth-form (Fig. 6E, 6K & 6L) and generally larger dimensions throughout (Fig. 6F, 6G, 6H, 6I & 6J). Plants of *J. montana* var. *litoralis* differ from plants of the other two varieties in their greater breadth, which is almost equal to their height (Fig. 6E & 6L), and their smaller flowering heads (Fig. 6B & 6C).

Thus these multivariate analyses have supported the separation of British Isles *J. montana* into three varieties; *J. montana* var. *montana*, *J. montana* var. *litoralis* and *J. montana* var. *latifolia* and have shown that morphological differences exist between populations of *J. montana* s.s. from different areas of Britain.

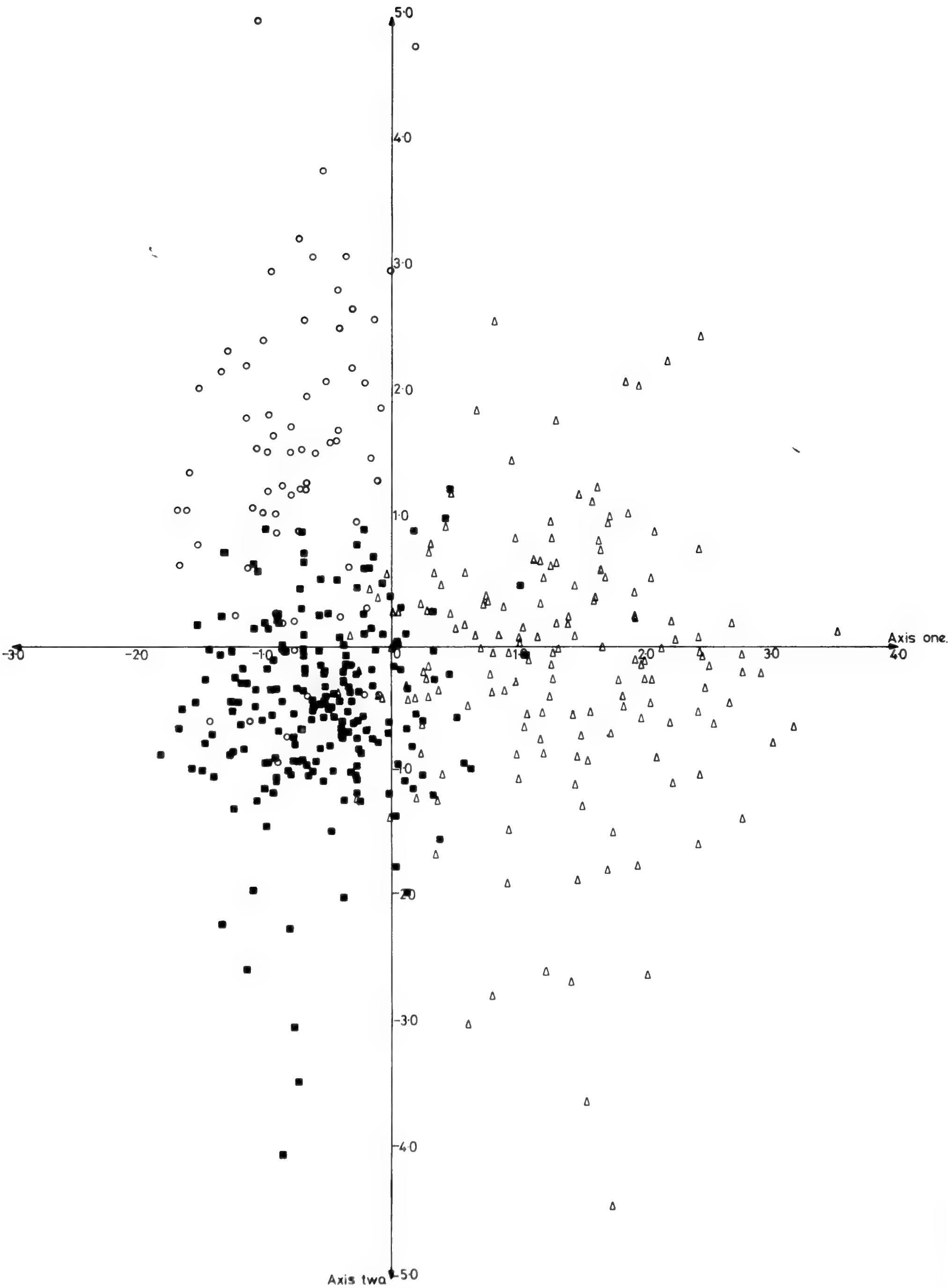

FIGURE 4. Principal components analysis on all plants sampled. The 500 plants giving the greatest degree of overlap are plotted. Axis One and Axis Two account for 40% and for 12% of the total variance respectively. ○=*J. montana* var. *litoralis*, △=*J. montana* var. *latifolia*, ■=*J. montana* var. *montana*.

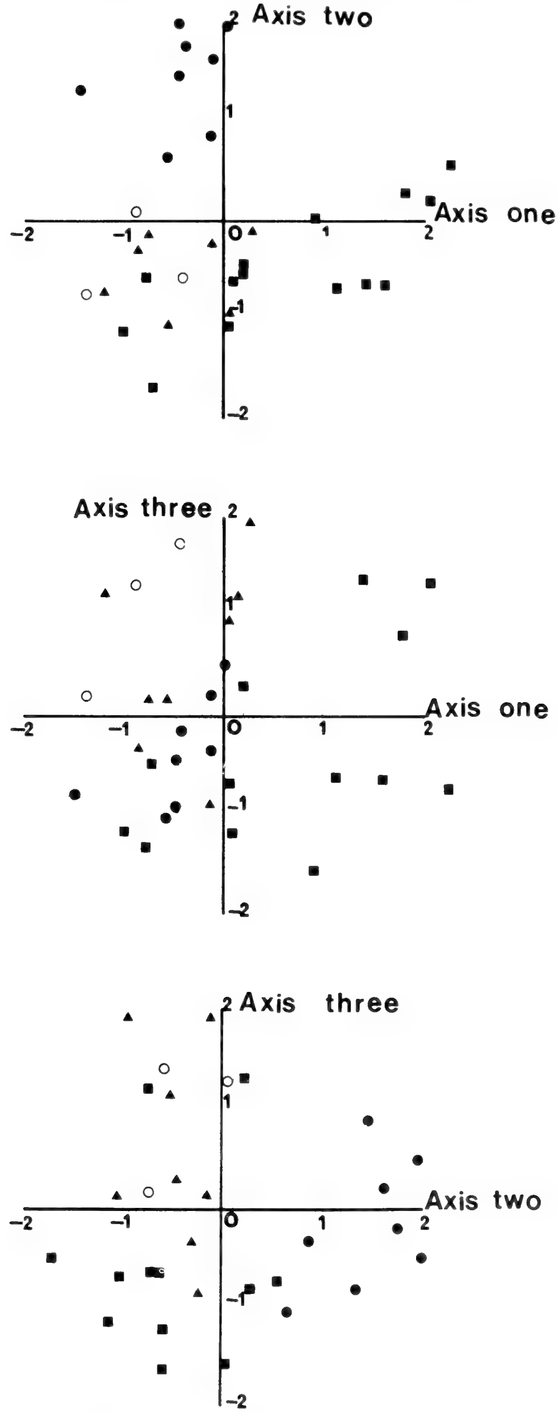

FIGURE 5. Principal components analysis of *J. montana* var. *montana* populations. Axes One, Two and Three account for 52%, 15% and 11% of the total variance respectively. ●=Scottish material, ○=Welsh material, ▲=Dorset material, ■=Cornish and Devon material.

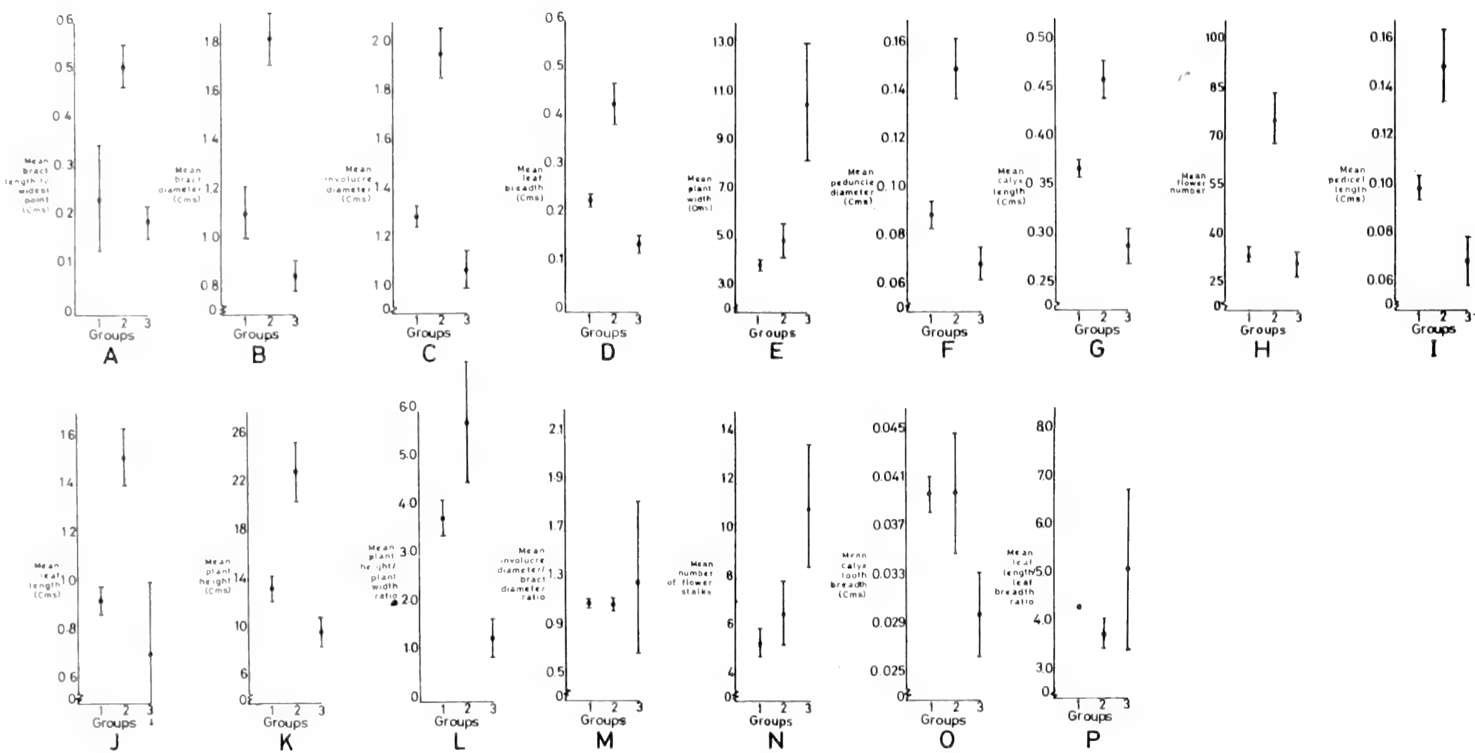

FIGURE 6. Mean values with 99.5% confidence limits for 16 characters measured in three groups. Group 1=*J. montana* var. *montana*, Group 2=*J. montana* var. *latifolia* and Group 3=*J. montana* var. *litoralis*.

STABILITY OF THE MORPHOLOGICAL GROUPINGS RECOGNIZED

A number of populations representing all the varieties of *J. montana* were grown under uniform environmental conditions. Plants were inspected and morphological measurements made on them at maturity. These measurements were plotted in the form of polygraphs and were also used in conjunction with the DSC functions already obtained from the wild populations (see above) to estimate the genetic component of the variation pattern of the varieties.

Representative polygraphs of the populations before and after cultivation are shown in Fig. 7. Wild populations are designated S16 (*J. montana* var. *montana*), I05 (*J. montana* var. *latifolia*), S05 and S14 (*J. montana* var. *litoralis*), and C10 (*J. montana* var. *maritima*). After cultivation under experimental conditions, the populations bear the prefix E, e.g. ES16.

J. montana var. *litoralis* populations (S05 &S14) vary in their response to cultivation (ES05 & ES14) (Fig. 7). ES05 plants maintain their diagnostic characteristics on cultivation, e.g. low height to width ratio but ES14 plants do not and come to resemble the experimental population of *J. montana* var. *montana* (ES16). Thus it seems that there are genetically determined plants assignable to *J. montana* var. *litoralis* but that there are also plants which, though similar in morphology, are in reality ecads or phenotypic copies of that taxon. This pattern of results was repeated in other tested populations of *J. montana* var. *litoralis*. Wild populations of *J. montana* var. *maritima* (C10) changed greatly on cultivation (EC10, Fig. 7) and came to resemble *J. montana* var. *montana* (ES16). *J. montana* var. *latifolia* (I05) remained distinct on cultivation (EI05, Fig. 7).

DSC analysis was used to test whether population means had shifted under cultivation, i.e. whether wild populations and the cultivated populations derived from them would be classified into the same group by DSC. DSC supported the conclusions drawn from the polygraphs by assigning all plants of EI05 to *J. montana* var. *latifolia*, ES05 to *J. montana* var. *litoralis* and ES16, ES14 & EC10 to *J. montana* var. *montana*.

Thus these experiments have shown firstly that plants grown from seed taken from natural populations of *J. montana* var. *litoralis* and *J. montana* var. *latifolia* maintain their distinctive morphologies on cultivation in uniform conditions and that the characteristics used to distinguish them are therefore genetically determined; secondly that phenotypic copies of *J. montana* var. *litoralis* exist and finally that plants of *J. montana* var. *maritima* do not maintain their dwarf stature on cultivation.

CROSSING EXPERIMENTS AND OBSERVATIONS ON POLLEN FERTILITY

Crossing experiments and observations on pollen fertility (Parnell 1980, 1982d, 1985) revealed no evidence of breeding barriers between or within any of the varieties. Artificial geitonogamous pollination, i.e. pollination between different flowers on the same inflorescence, produced a moderate amount of seed whereas strictly autogamous pollination did not. The distance seeds are likely to be dispersed in natural populations was likely to be less than 1.5 m, serving to restrict gene flow. Pollen infertility was variable both within an inflorescence and between different plants within a population and was also in some populations surprisingly high (c.36%), the infertility possibly acting as an insurance against excessive inbreeding (Parnell 1982d). So, despite the obvious physical adaptations of *J. montana* flowers to outcrossing (Knuth 1909; Parnell 1982d), successful inbreeding can and probably does occur at a fairly high frequency in natural populations.

THE VARIATION OF BRITISH ISLES MATERIAL

Experimental analysis has shown that it is possible to recognise taxonomically distinct, genetically determined, fully interfertile varieties of *J. montana* in the British Isles – *J. montana* var. *litoralis* and *J. montana* var. *latifolia*. The former is an ecotype confined to sand-dunes (Parnell 1980) whilst the latter grows on cliff-tops and roadside banks near the sea. Scattered populations of both occur throughout the British Isles. In general, Parnell (1982a) showed that *J. montana* is cytologically very uniform with n=6 or 2n=12 but that *J. montana* var. *litoralis* is unique in the occasional possession of either one or two β chromosomes. Neither ecotype has a geographically circumscribed distribution and therefore neither warrants subspecific status.

Plants formerly recognized as *J. montana* var. *major* and *J. montana* var. *laevis* cannot be separated from *J. montana* var. *montana* and should not be maintained at varietal rank. Equally,

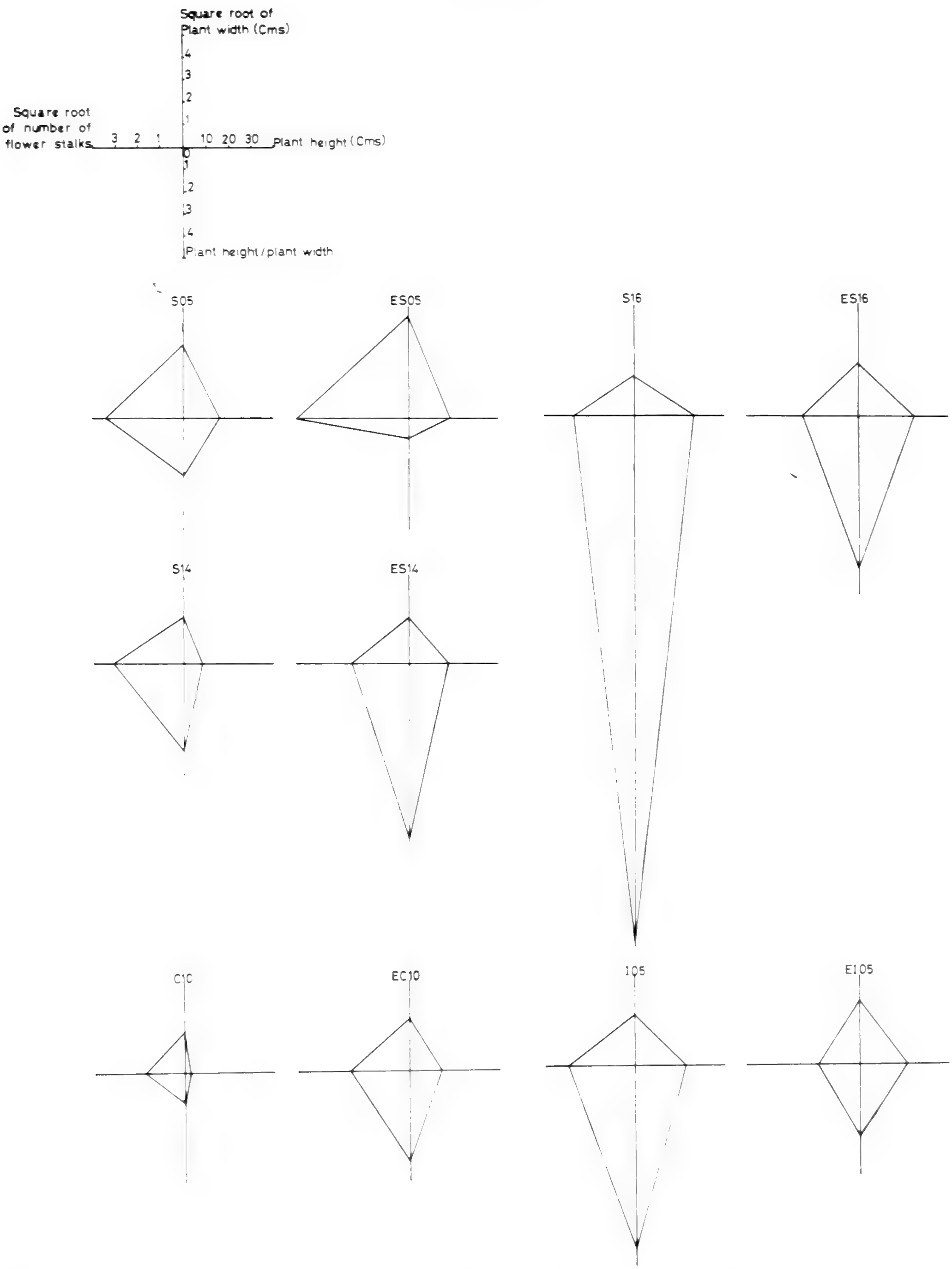

FIGURE 7. Polygraphs illustrating the morphological differences between and within populations of *J. montana* s.l. after growth under experimental conditions (prefixed by E) as compared with wild material. Wild populations are *J. montana* var. *montana* (S16), *J. montana* var. *latifolia* (I05), *J. montana* var. *litoralis* (S05 & S14) and *J. montana* var. *maritima* (C10).

plants of *J. montana* var. *maritima* fail to maintain their distinctive features on cultivation and therefore do not warrant recognition.

The geographical differences noted between northern and southern *J. montana* are small in comparison to the genotypical differences noted above and do not warrant formal taxonomic recognition.

The possibility that *J. montana* can act as an inbreeder has, surprisingly, not been suggested before. Undoubtedly geitonogamy must be of fairly common occurrence in any plant which bears more than a single flower and is not an obligate inbreeder. Why, in *J. montana*, such pollination should result in successful seed set whereas autogamous pollination does not is unknown. What is obvious though is that the morphology of *J. montana* belies its ability to self-fertilize. Such self-fertilization can be, at least to some degree, balanced by genetic recombination. As *J. montana* has a low chromosome number (2n=12) and rather small chromosomes with mostly few, terminal chiasmata (c. 1.4 per bivalent (Parnell 1982a)), it is clear that its chromosomal system is also acting to restrict rather than increase genetic variability. The occurrence of such physical and genetic inbreeding mechanisms allows successful recombinants to be conserved and together with restricted gene flow may allow the establishment of small morphological differences in plants from northern and southern Britain or northern and southern Europe.

VARIATION IN *J. MONTANA* THROUGHOUT THE REMAINDER OF ITS RANGE

CONTINENTAL MATERIAL

Analysis of herbarium specimens and natural plant populations of *J. montana* showed that the small morphological differences seen between *J. montana* from northern Scotland and south-western England (see above) were paralleled in material from continental Europe. For example, *J. montana* from southern Scandinavia is similar to Scottish material whereas that from central and southern Spain differs in its larger, often more deeply toothed bracts and pale green leaves. However, numerous intermediates connect northern and southern European specimens and there is no sharp discontinuity between them.

Spanish *J. montana* is very variable and two subspecies have been recognized, viz. *J. montana* subsp. *echinata* (Boiss. & Reuter) Rivas-Martinez and *J. montana* subsp. *blepharodon* (Boiss. & Reuter) Rivas-Martinez. The former subspecies is distinguished by its usually pale green, often hispid, leaves, purple, very deeply toothed and often strongly papillose outer involucral bracts and hispid calyx. However numerous intermediates between this and *J. montana* s.s. occur in Spain and also in Sicily, e.g. plants from the Sierra Marenna, near Cordoba (Spain), collected by Wilmott in **BM** have all of the above features except for the toothed purple bracts. The combination of characters defining *J. montana* subsp. *echinata* also breaks down because in the rest of the range of *J. montana*, e.g. in Britain, rare individuals occur which have the bract characteristics of *J. montana* subsp. *echinata* but none of the other features (*Parnell* in **ABD**). No chromosome counts are available for *J. montana* subsp. *echinata*. *J. montana* subsp. *blepharodon* is distinguished on the basis of its long (>2.7 mm), often basally ciliate calyx teeth, its generally sub-sessile flowers and large, ovate, more or less entire bracts. This combination of characters is unique. However, as both the number and position of the ciliate hairs on the calyx teeth is very variable (a situation similar to the variation in pubescence of the hypanthium of British *J. montana*) as is also the relative size and shape of the involucral bracts, it is clear that this combination of characters also breaks down. Finally, intermediates between these two subspecies also occur, e.g. *Reverchon 195* from Andalucia in **E** has ciliate calyx teeth and sub-sessile flowers but deeply toothed, purplish, strongly papillose outer involucral bracts. Bjorkqvist *et al.* (1969) showed that *J. montana* subsp. *blepharodon* had chromosomes which were numerically and morphologically identical with *J. montana* s.s.

Specimens of *J. montana* from the cliffs and dunes of the Atlantic coasts of Finisterre (Spain) and the Gironde (France) have often been distinguished as *J. montana* var. *sabularia* Cout. Typically, these decumbent plants (Fig. 8) bear short, imbricate, strigose leaves which have a markedly revolute margin. This combination of characters is unique and seems to occur only in specimens from coastal habitats in this region. Unfortunately the lectotype (in **BM**) and original description of this taxon (Coutinho 1913) neither correspond to the description given above nor in

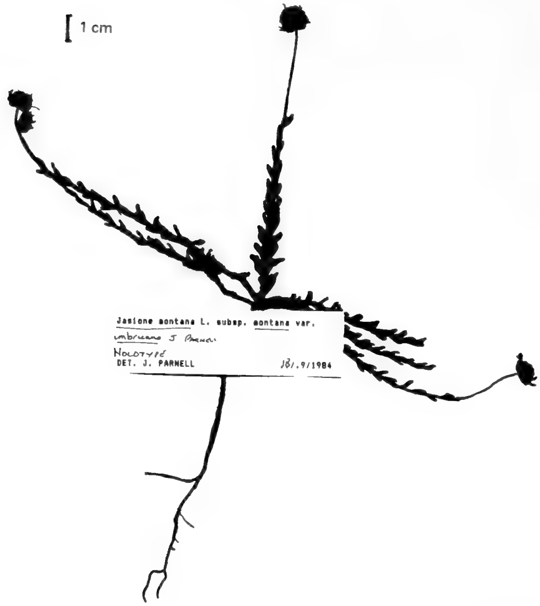

FIGURE 8. Holotype of *J. montana* L. subsp. *montana* var. *imbricans* J. Parnell. Finisterre, 1928, *Lacaita 32283* (**BM**).

fact refer to a distinguishable taxon. Thus *J. montana* var. *sabularia* Cout. has been consistently misinterpreted. *J. montana* var. *sabularia* auct. non Cout. has the same habit as *J. montana* var. *litoralis* and is probably closely related to it.

Thus, though there is considerable morphological variation in continental European *J. montana*, the differences between specimens are often dependent on their distance apart with seemingly acute differences breaking down when plants from intermediate geographical localities are considered. *J. montana* var. *sabularia* Cout. is indistinguishable from *J. montana* s.s. However, *J. montana* var. *sabularia* auct. non Cout. is distinct, and bears a close relationship to *J. montana* var. *litoralis*.

NORTH AFRICAN MATERIAL

Jasione cornuta Ball is endemic to north-western Africa and differs from typical *J. montana* in its long, apiculate, large involucral bracts, relatively broad, papillose leaves (Fig. 9) and occasionally fimbriate calyx teeth. Some *J. cornuta* is different from any southern Spanish material notwithstanding an obviously close relationship between them. It would seem that the apiculate bracts and fimbriate calyx teeth of *J. cornuta* are a yet more extreme example of the great variation in bract and calyx characters that occurs throughout the range of *J. montana*, being especially noticeable in southern Spain and exemplified there by *J. montana* subsp. *blepharodon*. The broad, papillose leaves of *J. cornuta* also indicate a close relationship to *J. montana* subsp. *echinata* where these features occur in a less extreme form. Some specimens of *J. cornuta* are also obviously closely related to *J. corymbosa* Poiret and intermediates between the two species occur.

J. cornuta and southern Spanish *J. montana* share a number of morphological features. However the morphological differences between *J. cornuta* and *J. montana* s.l., combined with the geographical isolation of the former, mean that *J. cornuta* is best treated as a subspecies of *J. montana*, as suggested by Greuter (1981), though no reasons are given.

RELATED SPECIES

Both *J. corymbosa* Poiret ex Schultes and *J. penicillata* Boiss. have been treated as subspecies of *J. montana* by Greuter (1981) and Rivas Martinez (1976) respectively. *J. penicillata* is strongly

FIGURE 9. Plants of *J. montana* L. subsp. *cornuta* (Ball) Greuter & Burdet, collected from Morocco illustrating its long apiculate bracts and broad leaves. Morocco, 13/4/1969, *P. & J. Davis D 49337* (**E**).

pubescent, probably annual, endemic to the Sierra Tejeda and surrounding mountains and differs from all non-teratological *J. montana* in being usually unbranched, though the lectotype in **G** is highly branched, in bearing leaves all the way up the peduncle (Fig. 10), and in its linear-spathulate, apically villous calyx teeth. Its relatively isolated geographical location and unusual morphology indicate that it is best maintained at specific rank. *J. corymbosa* is typically a stout glabrous or hispid annual which is again leafy almost to the apex of the peduncle (Fig. 11), has subulate, villous calyx teeth and differs from all *J. montana* in usually bearing short, fastigiate inflorescence branches. It occurs in southern Spain and Morocco. Cytologically it is similar to *J. montana* s.s. with 2n=12 and has a similar karyotype (Parnell unpublished). In its common state it is so distinct from *J. montana* that it would seem best to retain it at specific rank.

J. heldreichii Boiss. & Orph. is morphologically similar to *J. montana*, differing largely in its lanceolate, aristate, very deeply toothed, involucral bracts. The bract shape and the degree of toothing are so different from that of *J. montana* that *J. heldreichii* plants are always easily distinguishable. Some plants of *J. heldreichii*, from north-western Turkey, can be separated from the rest because of their short, triangular calyx teeth and very strongly papillose and marginally thickened leaves and involucral bracts. Such plants only occur in the same region of northern Turkey as *J. heldreichii* s.s. and so only warrant varietal rank (Fig. 12). *J. heldreichii* has 2n=12 and a similar karyotype to *J. montana* s.s. (Contandriopoulos 1966).

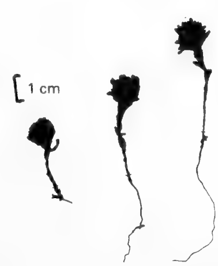

FIGURE 10. Plants of *J. penicillata* collected from Andalucia. Andalucia, 1889, *Reverchon 194* (**BM**).

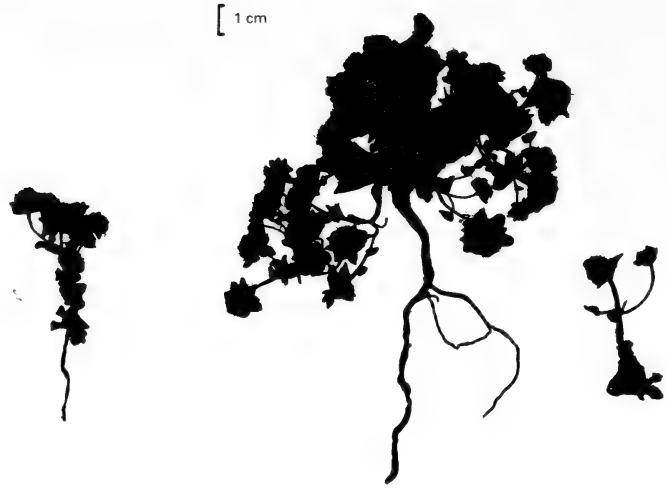

FIGURE 11. Plants of *J. corymbosa* collected from Morocco illustrating their generally fastigiate branching. Morocco, 29/6/1974 *Reading University/B.M. Exped. 1112* (**BM**).

FIGURE 12. Holotype of *J. heldreichii* Boiss. & Orph. in Boiss. var. *papillosa* J. Parnell. Istanbul, 8/8/72, *Uslu 2070* (**E**).

ENUMERATION OF TAXA

Only the synonyms of taxa recognized at the varietal level or above are cited. Sources for chromosome counts are given in Parnell (1982c) except where indicated.

1. *JASIONE MONTANA* L., *Sp.Pl.*, 928 (1753).
Jasione vulgaris Gaterau, *Descr. Pl. Montauban*, 153 (1789).
Jasione undulata Lam., *Encycl. Méth. Bot.*, 215 (1789), pro parte, excl. var. *ß*.
Jasione appressifolia Pau in *Not. Bot. Fl. Esp.*, **1**: 19 (1887).
Jasione espadanae Pau in *Not. Bot. Fl. Esp.*, **1**: 19 (1887).
Jasione adpressifolia Pau, orth. mut. ap. Willk., *Suppl. Prodr. Hisp.*, 126 (1893).
Jasione mediterranea Rouy, *Fl. Fr.*, **10**: 92 (1908).
Jasione hungarica Simonkai, nom. nud.

a. Subsp. *MONTANA*

i. Var. *MONTANA*
Jasione montana var. *ramosa* Latourette, *Chloris Ludgensis*, 25 (1785–1787), nom. nud.
Jasione montana var. *prolifera* Latourette, *Chloris Ludgensis*, 25 (1785–1787), nom. nud.
Jasione montana var. *major* Mert. & Koch in Röhling, *Deutschl. Fl.*, 147 (1826).
Jasione montana var. *laevis* Duby, *Bot. Gall.*, 311 (1828).
Jasione montana var. *hirsuta* Duby, *Bot. Gall.*, 311 (1828).
Jasione montana var. *prolifera* A.DC., *Monogr. Campan.*, 102 (1830).
Jasione montana var. *maritima* Bréb., *Fl. Normand.*, 179 (1835).
Jasione montana var. *glabra* Petermann, *Fl. Lips. Excurs.*, 168 (1838).
Jasione montana var. *stolonifera* DC., *Prodr.*, 415 (1839).
Jasione montana var. *gracilis* Lange, *Pug. Pl. Hisp.*, 155 (1861).
Jasione montana var. *genuina* Willk. in Willk. & Lange, *Prodr. Fl. Hisp.*, **1**: 126 (1870).
Jasione montana var. *gracilis* Timbal-Légrave in *Bull. Soc. Sci. Phys. Nat. Toulouse*, **3**: 419 (1875–1876).
Jasione montana var. *typica* Trautvetter in *Acta Horti Petrop.*, **6**: 44 (1879).
Jasione montana var. *hispida* G. Beck., *Fl. Nieder-Osterr.*, 1110 (1890).
Jasione montana var. *boraei* Rouy, *Fl. Fr.*, **10**: 91 (1908).
Jasione montana var. *timbali* Rouy, *Fl. Fr.*, **10**: 91 (1908).
Jasione montana var. *sabularia* Coutinho, *Fl. Port.*, 603 (1913).
Jasione pyrenaica var. *semiglabra* Sennen, *Plantes de Pyrenées-Orientales*, 5726 (1927), nom. nud.
Jasione montana var. *glaberrima* Podpěra in Polvíka, Domin & Podpěra, *Klíč k úplné květeně republiky C.S.R.*, 542 (1928).

More or less erect, sparingly branched (c. 2 flowering stems), usually villous biennials (rarely annual or short lived perennial) 2–60 cm tall. Stems usually leafless in their upper and leafy in their lower halves. Aerial leaves (0.9×0.2 cm) linear-oblong to lanceolate, always entire and often undulate (rarely crenate), the margin, unthickened, often weakly papillose and sometimes ciliate. Peduncles thin (<1 mm), outer involucral bracts, dark green, occasionally weakly papillose, ovate, parabolic, inner bracts, green or colourless, linear to lanceolate sometimes ovate, sometimes entire but more often crenate, serrate or laciniate, shorter than the flowers. Calyx teeth usually c. 2 mm long, subulate, green and often pubescent but never ciliate or fimbriate. Corolla usually blue, sometimes white or pink, <40 flowers in the primary inflorescence. Various abnormal forms of this variety occur and are described in Parnell (1982b, 1982c) and Scannell (1977). Distribution: throughout the range of the species excluding North Africa. n=6, 2n=12.

ii. Var. *ECHINATA* (Boiss. & Reuter) Willk. & Lange, *Prodr. Fl. Hisp.*, **2**: 282 (1870).
Jasione echinata Boiss. & Reuter, *Pugillus*, 73 (1852). Type: Gauchin, 1837, *Boissier* (Lectotype: **G**! fide Burdet, Charpin & Jacquemoud, in *Candollea*, **38**: 414). *Jasione montana* subsp. *echinata* (Boiss. & Reuter) Rivas-Martinez in *Publ. Inst. Biol. Appl. Barcelona*, **42**: 122 (1967).
Jasione montana var. *dentata* sensu Boissier, *Fl. Orient.*, **3**: 885 (1875) et auct.

Jasione montana var. *arenaria* Boiss. in sched.
Jasione stricta Pomel, *Nouv. Mat. Fl. Atl.*, 1 (1874).
Jasione montana var. *cartiliginea* Sennen, *Plantes d'Espagne*, No. 3461 (1918), nom. nud.

Plants are erect and sparingly branched 2–15 (−30) cm tall. Differs from var. *montana* in the usually pale green leaves, and pale green, often hispid, often generally purplish, long, thin, very deeply toothed and strongly papillose outer involucral bracts. Distribution: mainly in south-western Europe (Spain) but also in North Africa, Sicily, Italy and Corsica.

iii. Var. *BRACTEOSA* Willk. in *Bot. Zeit.*, **5**: 863 (1847).
Jasione blepharodon Boiss. & Reuter, *Pugillus*, 172 (1852). Type: Gibraltar, 1849, *Boiss. & Reuter* (Lectotype: **G**! fide Burdet, Charpin & Jacquemoud, in *Candollea*, **38**: 412 (1983)). *Jasione montana* subsp. *blepharodon* (Boiss. & Reuter) Rivas-Martinez in *Candollea*, **31**: 113 (1976); *Jasione corymbosa* Poiret ex Schultes in Roemer & Schultes var. *blepharodon* (Boiss. & Reuter) Batt., *Fl. Alger. Dicot.*, 571 (1889).
Jasione montana var. *littoralis* Boiss., *Voy. Bot. Midi. Esp.*, **2**: 396 (1839) non *J. montana* var. *litoralis* Fr., *Nov. Fl. Suec.*, 269 (1814). (I have been unable to find any specimens of this taxon and Burdet *et al.* (1983) have been unable to trace any in **G**. However, Boissier's original description and subsequent synonymy (Boissier & Reuter (1852)) makes this the most likely resting place for it.)
Jasione baetica Rodrig. in sched.

Differs from var. *montana* in being usually annual with papillose leaf-margins, ovate outer involucral bracts, mostly subsessile flowers and long (>2.7 mm), ciliate calyx-teeth. Distribution: mainly in south-western Europe (Spain). 2n=12.

iv. Var. *LATIFOLIA* Pugsl. in *J. Bot., Lond.*, **59**: 215–216 (1921). Type: Bray Head, Co. Wicklow, 1881, *Britten & Nicholson* (Lectotype: **BM**!, designated here).
Jasione montana var. *megaphylla* Vicioso in *Anal. Jardin Botanico de Madrid*, **6**: 79 (1965).

Differs from var. *montana* in its lanceolate-spathulate leaves with thickened but not strongly papillose leaf-margins, thickened peduncles (c. 1.5 mm), large inflorescences with ovate involucral bracts projecting beyond the edge of the inflorescence and with usually >60 flowers in the main inflorescence. Distribution: scattered throughout Europe. n=6.

v. Var. *LITORALIS* Fr., *Nov. Fl. Suec.*, 269 (1814). Type: Halmstad par., Halmstad Holland, 1814, *E. Fries* (Lectotype: **UPS**! Lower specimen, designated here).
Jasione montana var. *littoralis* Koch, *Syn. Fl. Ger.*, 463 (1837).
Jasione montana var. *tenella* Petermann, *Fl. Lips. Excurs.*, 168 (1838).
Jasione montana var. *nana* Boreau, *Fl. Centre Fr.*, **2**: 286–287 (1840).
Jasione montana var. *nana* Gren. & Godron, *Fl. Fr.*, **2**: 398 (1850).

Differs from var. *montana* in having decumbent to ascending flowering stems. Plants are usually as tall as they are wide with >8 flowering stems and small (0.5–2 cm), narrow (c. 2 mm wide) leaves. Distribution: mainly on the coasts of Europe and Scandinavia (on sand) but also inland (on sand or granitic rocks). n=6 or n=6+1β or n=6+2β.

vi. Var. **IMBRICANS** J. Parnell, **var. nov.**
Typus: Finisterre, 1928, *Lacaita 33283* (Holotypus: **BM**). Fig. 8.
Jasione montana var. *sabularia* auct. non Cout.

A varietate *montana* habitu decumbent et a varietate *montana* et varietate *litorali* caulibus floriferis paucis (1–3), foliis brevibus strigosis imbricatis marginibus saepissime revolutis, differt.

Differs from var. *montana* in its decumbent habit and from both var. *montana* and var. *litoralis* in its few (<4) flowering stems with short, imbricate, strigose leaves which usually have a strongly revolute margin. Distribution: coasts of Finisterre (Spain), Gironde (France).

b. Subsp. *CORNUTA* (Ball) Greuter & Burdet in *Willdenowia*, **11**: 40 (1981).
Jasione cornuta Ball in *J. Bot., Lond.*, **11**: 373 (1873). *Jasione corymbosa* subsp. *cornuta* (Ball) Murbeck in Jahandiez & Maire, *Cat. Pl. Maroc.*, 737 (1934).

Differs from subsp. *montana* in being usually annual with pale green leaves with strongly papillose margins, ovate, long acuminate outer involucral bracts, and linear/linear-spathulate aristate and often weakly fimbriate calyx teeth. Distribution: North Africa only.

2. *JASIONE PENICILLATA* Boiss., *Elenchus*, 63 (1838). Type: Sierra Tejeda, 1837, *Boiss.* (Lectotype: **G**! fide Burdet, Charpin & Jacquemoud in *Candollea*, **38**: 416 (1983)).
Jasione blepharodon subsp. *penicillata* (Boiss.) Rivas Goday in *Bol. Soc. Brot., ser. 2*, **47**: suppl. 168 (1973). *Jasione montana* subsp. *penicillata* (Boiss.) Rivas Martinez in *Candollea*, **31**: 113 (1976).

Differs from *J. montana* in being an annual or short-lived biennial 1–10 cm tall without a distinct leaf rosette but with lanceolate, entire aerial leaves 0.9×0.2 (-0.3) cm with a thin, neither undulate nor papillose margin and with the peduncle usually leafy up to the capitulum. Distribution: Sierra Tejeda and surrounding mountains, Spain.

3. *JASIONE CORYMBOSA* Poiret ex Schultes in Roemer & Schultes, *Syst. Veg.*, **5**: 474 (1819). Type: Tangier, 1794–1799, *Broussonet* (Lectotype: **M**!, designated here).
Jasione corymbosa Poiret in Lam., *Encycl. Méth. Bot. Suppl.*, **3**: 130 (1813), nom. prov.; *Jasione montana* subsp. *corymbosa* (Poiret) Greuter & Burdet in *Willdenowia*, **11**: 40 (1981) nom. illegit.

Differs from *J. montana* in being usually 3–10 (-15) cm tall, often fastigiately branched and with spathulate to ovate or obovate aerial leaves (6×2–4 mm) generally present up to the capitulum. 2n=12 (Parnell, unpublished). Distribution: southern Spain and Portugal and north-western Africa.

i. Var. *CORYMBOSA*.
As above and also usually villous.

ii. Var. **GLABRA** (Durieu ex Boiss. & Reuter) J. Parnell, **stat. et comb. nov.**
Jasione glabra Durieu ex Boiss. & Reuter, *Pug. Plant. Nov.*, 72 (1852). Type: Oran, 1840–1842, *Durieu* (Lectotype: **G**!, designated here). *Jasione corymbosa* subsp. *glabra* (Durieu ex Boiss. et Reuter) Batt. in Batt. et Trabut, *Flore de l'Algerie*, 570–571 (1888–1897).
Jasione arenaria Salzm. in sched.

Differs from var. *corymbosa* in being spindly and more or less glabrous with ovate involucral bracts. Confined to sand-dunes and connected by intermediates to *J. cornuta*.

4. *JASIONE HELDREICHII* Boiss. & Orph. in Boiss., *Diag. Pl. Nov.*, **3(6)**: 120 (1859). Type: Macedonia, 1857, *Orph.* (Lectotype: **G**!, designated here).
Jasione jankae Neilr., *Aufz. Ungarn. Slavon. Gefasspfl. Nachtrage und Verbesserungen*, 43–44 (1870).
Jasione glabra Vel. in *Ost. Bot. Z.*, **34**: 424–425 (1884).
Jasione heldreichii var. *microcephala* Vel., *Fl. Bulg.*, 374 (1891).

Differs from *J. montana* in having lanceolate, aristate, deeply toothed or cut/slashed involucral bracts. Biennial or perennial. Distribution: Balkan Peninsula and south-eastern Europe. 2n=12 (Contandriopoulos 1966).

i. Var. *HELDREICHII*

Jasione montana var. *dentata* DC., *Prodr.*, 415 (1839), non Boissier, *Fl. Orient.*, **3**: 885 (1875) et auct.

As above and with weakly papillose, slightly thickened leaf margins and green involucral bracts with long triangular calyx teeth.

ii. Var. **PAPILLOSA** J. Parnell, **var. nov.**

Typus: Istanbul, 1972, *Uslu 2070* (Holotypus: **E**!). Fig. 12.

A var. *heldreichii* foliis bracteisque involucri fortissime papillosis, marginibus conspicue incrassatis, bracteisque pagina interiore purpureis et dentibus calycis breviter (nec longe et anguste) triangularibus, differt.

Differs from var. *heldreichii* in its very strongly papillose and marginally thickened leaves, and involucral bracts which are also distinctly purple on their inner surface and in having short triangular calyx teeth. Distribution: north-western Turkey.

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The pattern of morphological variation in the *Salicornia europaea* L. aggregate (Chenopodiaceae)

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ABSTRACT

A numerical taxonomic analysis of diploid *Salicornia* L. (Chenopodiaceae) plants from four salt marshes in W. Sussex (v.c. 13) and Essex (v.cc. 18 & 19) was carried out by minimum variance clustering (Ward's Method) and principal components analysis. The pattern of morphological variation both between and within marshes provides no evidence for the separate recognition of *Salicornia europaea* L. and *S. ramosissima* J. Woods.

INTRODUCTION

In the British flora, the distinction between perennial and annual species, and between diploid (2n=18) and tetraploid (2n=36) species of *Salicornia* L. (Chenopodiaceae) is well established. The woodiness of *Salicornia perennis* Miller (=*Arthrocnemum perenne* (Miller) Moss) clearly identifies it. Diploid and tetraploid annual species may be distinguished by a number of characters. The number of stamens, the shape of the spike-segment, the length of the terminal spike, the angle of the upper branches to the main stem and the size of the lateral flowers in relation to the central flowers are all useful characters in the field (Ball & Tutin 1959; Ball 1964; Ball & Brown 1970). It is within each ploidy level where difficulties arise, especially for the non-expert.

A major difficulty in *Salicornia* taxonomy emerged in the course of an ecophysiological study on salt marshes in Norfolk, Essex, W. Sussex and Pembrokeshire. In a few locations it proved difficult to distinguish taxa, especially the diploids, even when typical representatives of each species were present within a single marsh.

The first edition of *Flora of the British Isles* (Clapham *et al.* 1952) records three diploid species in the *S. stricta* Dumort aggregate (=*S. europaea* L.), and three diploid species in the *S. prostrata* Pallas aggregate, as well as *S. disarticulata* Moss (=*S. pusilla* J. Woods). The second edition (Clapham *et al.* 1962) reduces these species to four: *S. europaea*, *S. ramosissima* J. Woods (including the *S. prostrata* agg.), *S. pusilla* and *S. obscura* P. W. Ball & Tutin. This trend in the reduction of numbers of species recognized was outlined by Ball (1964) in *Flora Europaea*, where *S. obscura* is recorded as a probable variant of *S. europaea*. Of the three British diploid species presently recognized, *S. pusilla* is distinctive in having a single floret in each cyme rather than the normal three florets of *S. europaea* and *S. ramosissima*. This study is confined to the last two species as these are often the most difficult to distinguish in the field.

Of the distinguishing features between *S. europaea* and *S. ramosissima*, emphasis is placed on the width of the lower fertile segments of the terminal spike, the width of the scarious border and the colour of the segments and cymes (Ball & Tutin 1959; Clapham *et al.* 1962; Ball 1964). However, there is a range of overlap and variation in these characters that make their use difficult. Furthermore, any segment colouring serves to highlight the scarious border and perhaps over-emphasize its importance. It was found that identification of the two species at any one location was generally reliable if the habitat and colour differences were distinct. For example, at Itchenor in W. Sussex (v.c. 13), *S. europaea* is found on the lower marsh associated with bare ground and the tetraploid *S. dolichostachya* Moss, and here its colour is generally dark green with some red round the cyme. *S. ramosissima* is found on the middle and upper parts of the marsh, largely associated with *Puccinellia maritima* (Hudson) Parl., with the segments and cymes coloured purple. The two populations are separated by a broad, almost pure zone of *Spartina anglica* C. E.

Hubbard. Less well-defined marshes, or marshes heavily dissected with creeks, often make such identification more difficult because the habitats are less clearly defined. However, phenological and genotypic studies have shown that differences between the two species at these levels do exist and have emphasized the habitat differences (Jeffries *et al.* 1981; Jeffries & Gottlieb 1982). Jeffries & Gottlieb (1982), using electrophoresis, found that six out of 30 isozymes tested in diploid species at several locations were consistent with two distinct homozygous genotypes, representing *S. europaea* and *S. ramosissima*.

The aim of this study was to carry out a numerical taxonomic study on the morphology of several populations of both species and to determine whether inter-location and intra-location differences could be detected. Any such investigation suffers from the difficulty of maintaining in cultivation, on a regular basis, *Salicornia* plants. Although germination of seeds is easy, maintaining representative plants in terms of succulence and growth form has proved impossible so far. As a result this work has been carried out entirely on collections of wild material. The lack of any testing of genotype – environment interaction for any of the morphological characters measured is a severe drawback.

Of necessity, a classification of *Salicornia* must relate to the pattern of variation in nature since one of the most important requirements of a general purpose classification is that species can be identified by the field botanist. Although classifications can be erected for many purposes, a classification in which it is impossible to identify named taxa except by specialist techniques has a very restricted value.

MATERIALS AND METHODS

SAMPLED POPULATIONS

Both *S. europaea* and *S. ramosissima* are recorded as being common and locally abundant or dominant in the parts of Essex (Jermyn 1974) and W. Sussex (Hall 1980) that have been sampled.

Four salt marshes were sampled (Table 1), three in Essex (v.cc. 18 and 19) and one in W. Sussex (v.c. 13). Marshes were chosen that include typical representatives of *S. europaea* and *S. ramosissima*. At each locality the marsh was sampled at two sites at different levels. Plants were selected from the lower marsh sites from the most seaward populations of the mudflats at St Peter's, Canvey and Itchenor. At Tollesbury, the lower marsh is foreshortened by erosion and at this location plants were collected from the bare mud next to the eroded cliffs. Middle or upper marsh sites were those areas with the most landward group of plants of a reasonable size.

At each site on the marsh a relatively small area was sampled, keeping to the same altitude as much as possible. Underdeveloped or damaged plants and those outside the *S. europaea* group were ignored. For the purpose of this study the *S. europaea* group was defined as in *Flora Europaea* (Ball 1964), consisting of all 3-flowered diploid plants.

Plants were collected over a two week period in late September and kept in polythene bags at 4°C until being scored. It proved possible to keep plants fresh for 2–3 weeks in this way without any signs of shrinkage or distortion. Scoring took place within this period.

TABLE 1. SITE DETAILS OF SAMPLED POPULATIONS

Sampled site		Number of plants	Grid reference
N. Essex, v.c. 19			
Tollesbury	lower marsh	50	52/97.10
	middle marsh	50	
S. Essex, v.c. 18			
St Peter's	lower marsh	50	62/03.08
	middle marsh	50	
Canvey	lower marsh	24	51/82.83
	middle marsh	50	
W. Sussex, v.c. 13			
Itchenor	lower marsh	50	41/78.01
	upper marsh	49	

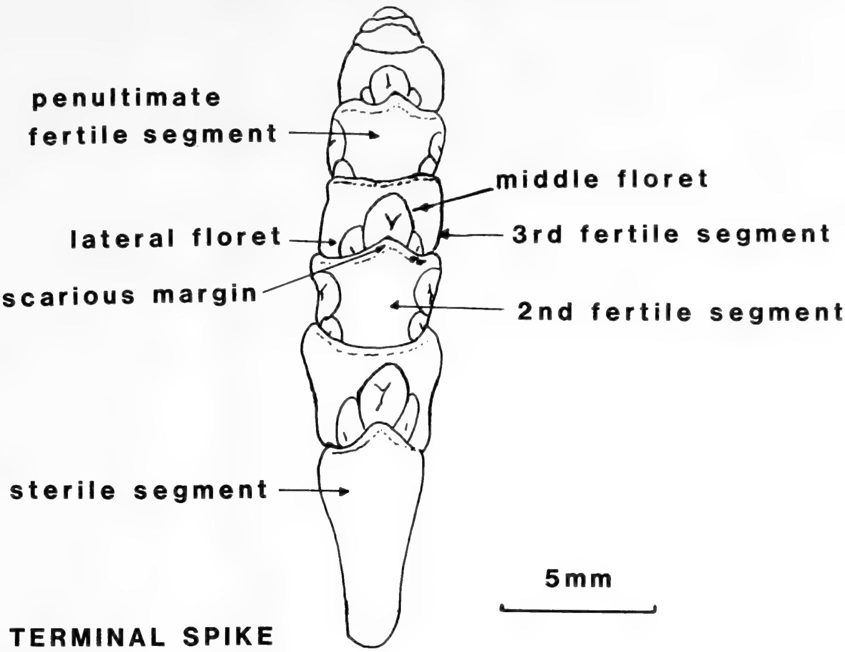


FIGURE 1. Spike characters.

SCORING OF CHARACTERS

Plants were scored for 52 characters consisting of 47 metric characters covering all parts of the plant (including the branching pattern, spike and floret size) and five multistate characters assessing the coloration of the sterile and fertile segments and of the florets of the terminal spike (Fig. 1). An additional 28 characters were derived as ratios of some of the initial 52 characters in order to assess the shape of the whole plant and parts of the terminal spike (Table 2).

In choosing characters, no attempt was made to identify 'useful' characters, nor to examine correlations between characters other than logically correlated characters, e.g. height of the spike and height of each of the segments making up the spike, which were rejected.

DATA PREPARATION AND NUMERICAL ANALYSIS

Initial data preparation was carried out on a Vax – 11/750 computer. Data sets consisting of matrices of individuals as Operational Taxonomic Units (OTUs) against characters were compiled. Characters were encoded as scored without adjustment, with ratio characters calculated and added to the sets.

Subsequent analysis was carried out on the following data sets:

a) all sites and populations consisting of 373 individuals and all 80 characters;

b) eight sets, one for each sampled site of all the individuals from a marsh and all 80 characters;

c) a reduced data set consisting of all 373 individuals and 36 characters – these being the ones relating only to the terminal spike (characters 30–52 and 64–76).

The analysis was carried out on the reduced data set as well as the whole data set in order to identify the effects of environmentally induced variability. One of the most obvious characteristics of *Salicornia* plants is the variation in height and branching pattern of plants on different parts of a marsh. This variability may be environmentally induced and leads to difficulty in the strict comparison of branch characteristics between a plant with and without branches. Terminal spike characters are strictly comparable (being always present) and may be the least environmentally labile characteristics. Subsequent data preparation was carried out by using procedures of the CLUSTAN package (Wishart 1978) release 2 version 1C on an Amdahl 470 computer. All further analysis was carried out using this package of clustering and ordination procedures.

TABLE 2. CHARACTERS SCORED FOR TAXOMETRIC ANALYSIS

	GENERAL MORPHOLOGY
1.	Height of plant from rooting point to apex
2.	Height from rooting point to 1st branching point
3.	Number of internodes
4.	Length of 1st internode
5.	Length of 2nd internode
6.	Length of penultimate internode
7.	Length of ultimate internode
8.	Length of longest 1st (basal) primary branch
9.	Number of fertile segments in 1st primary branch
10.	Number of sterile segments in 1st primary branch
11.	Length of longest 2nd primary branch
12.	Number of fertile segments in 2nd primary branch
13.	Number of sterile segments in 2nd primary branch
14.	Length of the longest penultimate branch
15.	Number of fertile segments in penultimate branch
16.	Number of sterile segments in penultimate branch
17.	Length of ultimate branch
18.	Number of fertile segments in ultimate branch
19.	Number of sterile segments in ultimate branch
20.	Distance from apex to apex of ultimate branch
21.	Distance from apex to apex of 1st primary branch
22.	Number of secondary branches in 1st primary branch
23.	Number of secondary branches in 2nd primary branch
24.	Branch node with the most secondary branches
25.	Maximum number of secondaries on a primary branch
26.	Length of longest secondary branch
27.	Number of fertile segments on the longest secondary
28.	Number of sterile segments on the longest secondary
29.	Length of the longest tertiary branch
	TERMINAL SPIKE CHARACTERS
30.	Length
31.	Number of fertile segments
32.	Number of sterile segments
33.	Maximum width of 3rd fertile segment
34.	Width of middle floret
35.	Width of 3 florets
36.	Width across apex of 2nd fertile segment
37.	Minimum width of 2nd fertile segment
38.	Maximum width of 2nd fertile segment
39.	Distance between florets on 2nd fertile segment
40.	Distance from tip of 3rd fertile segment to apex of middle floret
41.	Height of middle floret of 3rd fertile segment
42.	Height of side floret of 3rd fertile segment
43.	Height of triangular apex of 2nd fertile segment
44.	Width of the scarious margin of 2nd fertile segment
45.	Length of last sterile segment
46.	Maximum diameter of penultimate fertile segment
47.	Minimum diameter of penultimate fertile segment
48.	Colour of sterile segment*
49.	Colour of florets*
50.	Colour of fertile segments*
51.	Distribution of coloration**
52.	Sterile segments***

*Green or yellow=0, diffuse pink=1, red=2. **Basal or even=0, apical=1. ***Not yellow=0, yellow=1.

TABLE 2 cont'd. CHARACTERS SCORED FOR TAXOMETRIC ANALYSIS

RATIO CHARACTERS

53. 1/11
54. (1−2−8)/3
55. 54/(4+5)
56. 54/(6+7)
57. 23/8
58. 24/(8+1−2)
59. 11/14
60. 11/20
61. 17/20
62. 29/11
63. 29/32
64. 33/(40+41)
65. 34/41
66. 35/42
67. 37/43
68. 37/38
69. 35/39
70. 45/(40+41)
71. 38/46
72. 37/47
73. 46/47
74. 36/43
75. 33/37
76. 33/38
77. 45/7
78. 38/1
79. 8/20
80. 9/20

Before carrying out any statistical procedures, the data were standardized by converting to standard scores to give each measured character equal weighting. A similarity matrix with Squared Euclidean Distance as the measure of similarity between individuals (OTUs) was calculated. Subsequent ordination and clustering methods attempted to produce a low dimensional, but undistorted, simplification of this matrix.

Initially a principal components analysis was carried out and scatter diagrams of the first few components constructed.

Cluster analysis was performed using Ward's Method as the criterion for the fusion of clusters. Ward's Method attempts to find a set of clusters with the minimum total within cluster variance. Dendrograms were constructed to illustrate the cluster patterns produced.

The inclusion of so many characters, some of which are highly correlated, poses a number of problems. The inclusion of correlated characters may be justified theoretically on the basis that they each represent the phenotypic expression of a more basic but unmeasured pleiotropic gene or genes. The inclusion of different measures imposes a kind of objective weighting; the more times the expression of the pleiotropic gene is measured the more accurately it is assessed.

It is because of the problem of correlated characters that principal components analysis is so useful. Here the basis of the method is to seek to simplify the data matrix by finding character correlations. The results of a cluster analysis and a principal components analysis can validate each other.

The inclusion of many characters increases the possibility that numerical noise will conceal any patterns which exist but there is no way of choosing the best characters before the analysis is carried out except in an arbitrary, subjective manner. The alternative, as reported here, is to carry out the analysis, detect the best characters a posteriori, and then use these alone to see what pattern of variation exists. The best characters can be chosen a posteriori on the basis of having low intra-cluster variability and high inter-cluster variability, i.e. they are good cluster diagnostics.

TABLE 3. PERCENTAGE VARIABILITY ACCOUNTED FOR BY THE COMPONENTS OF THE PRINCIPAL COMPONENTS ANALYSIS

Component	Full data set (80 characters) % variability	cumulative %	Spike data set (36 characters) % variability	cumulative %
1	18.26	18.26	23.77	23.77
2	13.53	31.79	12.25	36.01
3	6.05	37.84	9.05	45.06
4	5.86	43.70	6.46	51.52
↓	↓	↓	↓	↓
15			1.87	90.76
29	0.76	90.43		

RESULTS

ORDINATION

Principal components analysis, both of the whole data set and the reduced (spike) data set, failed to identify any useful (i.e. discriminatory) components. The data were not summarized adequately by any of the first few components although the first four components accounted for about half of the total variability (Table 3). For example, the principal component scatter plots shown in Figs. 2 & 3 did not reveal any distinct groups or clusters. Rather there was a broad spread of individuals with no obviously distinct modes.

CLUSTER ANALYSIS

Clustering by Ward's method produced well defined clusters in both the whole and reduced data sets (Figs. 4 & 5) but it is necessary to validate the clustering procedure. In part this can be achieved by a comparison of different methods of analysis and by comparing the results of the one

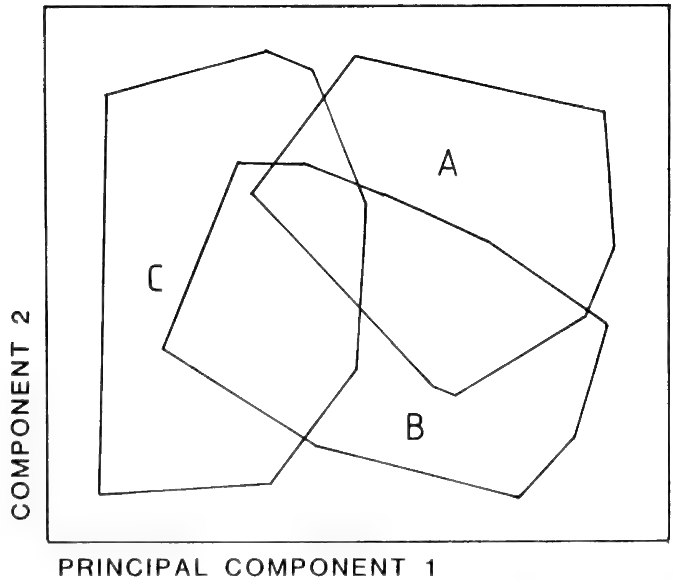


FIGURE 2. Principal component scatter diagram the first 2 components from an analysis of the whole data set. Clusters labelled as in Fig. 4 and in Table 4.

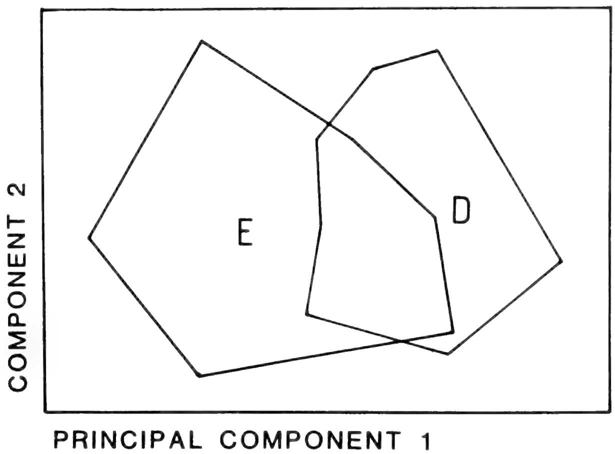
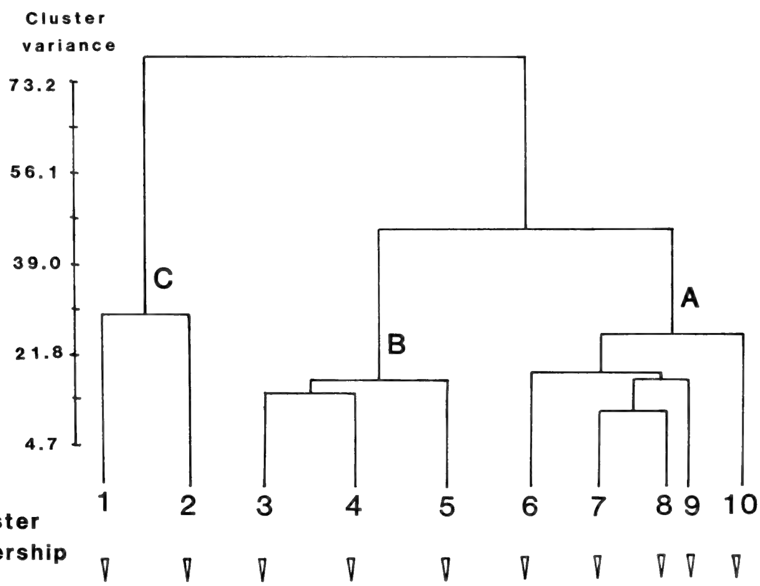
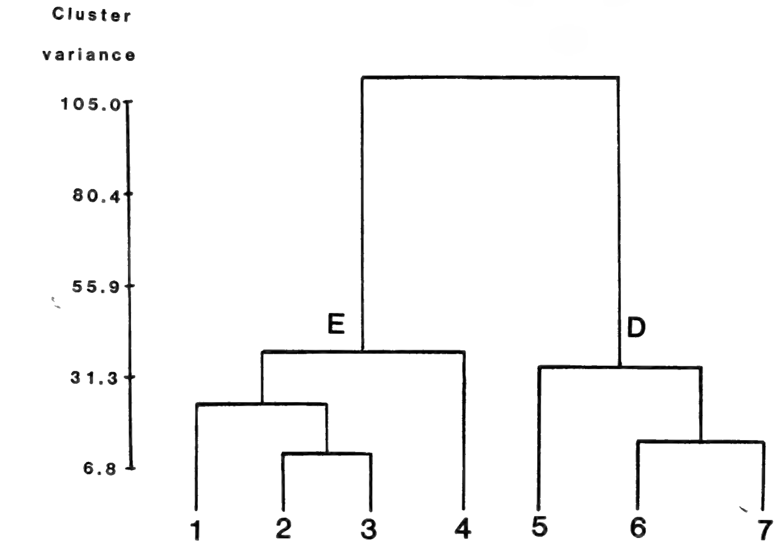


FIGURE 3. Principal component scatter diagram of the first 2 components from an analysis of the spike data set. Clusters labelled as in Fig. 5 and Table 5.



Cluster membership	1	2	3	4	5	6	7	8	9	10
Tollesbury										
lower marsh	–	–	4	7	–	1	1	21	6	10
middle marsh	–	–	–	26	2	4	9	–	–	9
Saint Peter's										
lower marsh	–	46	1	–	1	1	–	1	–	–
middle marsh	–	–	2	–	–	15	29	–	–	4
Canvey										
lower marsh	14	–	3	–	4	2	1	–	–	–
middle marsh	10	1	8	2	–	15	1	–	–	13
Itchenor										
lower marsh	2	–	–	1	44	–	–	–	–	3
upper marsh	1	–	29	6	–	8	–	2	–	3

FIGURE 4. Phenogram of cluster analysis of whole data set. Clusters A, B and C defined in Table 4. Source of cluster members at the 10 cluster phenon level indicated.



Cluster membership	1	2	3	4	5	6	7
Tollesbury							
lower marsh	13	6	8	10	2	3	8
middle marsh	7	2	4	1	-	29	7
Saint Peter's							
lower marsh	2	1	-	47	-		
middle marsh	28	2	14	1	-	3	2
Canvey							
lower marsh	9	1	2	-	1	10	1
middle marsh	4	21	4	1	10	3	7
Itchenor							
lower marsh	-	-	-	1	-	5	44
upper marsh	-	12	2	2	29	1	3

FIGURE 5. Phenogram of cluster analysis of spike data set. Cluster D and E defined in Table 5. Source of cluster members at the 7 cluster phenon level indicated.

clustering method (Ward's Method) on the different data sets. Since the clusters isolate different portions of the principal components scatter plots (Figs. 2 & 3), there is a correspondence between different methods of analysis. The phenograms based on the complete data set and the reduced (spike) data set showed a good correspondence especially at the lower levels of clustering, and therefore the clustering procedure is fairly stable.

More important than this kind of internal validation is biological validation to determine whether the clusters produced have any biological significance. The following points suggest that they do.

In the analysis of the whole data set of all the individuals, small clusters regularly identify single sampling sites. 65% of OTUs are most closely grouped to a cluster which is made up only of individuals from the same site. Most of these pure clusters are small ranging, with from two to eight individuals, but four clusters, two from the lower marsh at St Peter's and one each from Itchenor lower marsh and Tollesbury middle marsh, have 13–16 individuals. There are, in addition, a number of other clusters as large or larger which would be from a single site if not for a few mis-matched individuals (Fig. 4).

The best diagnostic characters which distinguish the large clusters of both phenograms (Figs. 4 & 5) are listed in Tables 4 & 5. Included is character no. 44, width of the scarious margin of fertile segments, which has been described as being important (Ball & Tutin 1959). Here it has proved to be a very poor diagnostic. The other characters, however, do act as good diagnostics and relate very well to those used in traditional classification.

The large clusters identify variants very similar to the accepted species concept (Ball 1964) especially clusters A & C of the cluster analysis of the full data set (Fig. 4).

TABLE 4. CHARACTER DISTRIBUTION OF THE THREE CLUSTER STAGE OF THE WHOLE DATA ANALYSIS

Character	*S. europaea* sensu Ball (1964)	Cluster Means A (n=157)	B (n=142)	C (n=74)	*S. ramosissima* sensu Ball (1964)
30. Spike length	10–50 mm	34.5 mm SD=8.3	22.8 mm SD=6.2	23.4 mm SD=8.7	5–30(40) mm
37. Minimum width of 2nd fertile segment	3–5 mm	3.6 mm SD=0.3	3.0 mm SD=0.4	3.1 mm SD=0.5	2.5–4 mm
44. Width of scarious margin	0.1 mm	0.18 mm SD=0.11	0.20 mm SD=0.12	0.24 mm SD=0.09	0.1–0.2 mm
64. Fertile segment width/length		1.6 SD=0.3	1.5 SD=0.3	1.9 SD=0.4	
49. Colour of florets	Diffuse Red	1.5 SD=0.6	2.0 SD=0.8	2.3 SD=0.8	Dark Red
2. Height to 1st branch		41.8 mm SD=26.1	42.9 mm SD=30.1	11.3 mm SD=6.2	
55. Internode unevenness		0.6 SD=0.2	0.6 SD=0.4	1.1 SD=0.5	
8. Length of basal branch		52.0 mm SD=28.2	55.0 mm SD=41.4	98.9 mm SD=39.8	
25. Max. no. of secondary branches	Simple – much branched	0.4 SD=0.5	0.5 SD=0.6	1.9 SD=0.5	Typically much branched
29. Length of longest tertiary branch		0.8 mm SD=3.0	0.1 mm SD=0.6	7.5 mm SD=7.4	
1. Height of plant	(100–)150–300(–350) mm	195 mm SD=43	179 mm SD=50	161 mm SD=40	30–400 mm
Source of cluster members					
Tollesbury	Lower marsh	39	11	0	
	Middle marsh	20	30	0	
St Peter's	Lower marsh	3	2	45	
	Middle marsh	47	3	0	
Canvey	Lower marsh	4	6	14	
	Middle marsh	30	10	10	
Itchenor	Lower marsh	3	43	4	
	Upper marsh	11	37	1	

SD=standard deviation.

TABLE 5. CHARACTER DISTRIBUTION AT THE TWO CLUSTER STAGE OF THE SPIKE DATA ANALYSIS

Character	*S. europaea* sensu Ball (1964)	Cluster Means D (n=168)	E (n=205)	*S. ramosissima* sensu Ball (1964)
30. Spike length	10–50 mm	34.5 mm SD=8.0	21.6 mm SD=6.0	5–30(–40) mm
37. Minimum width of 2nd fertile segment	3–5 mm	3.6 mm SD=0.3	2.9 mm SD=0.4	2.5–4 mm
44. Width of scarious margin	0.1 mm	0.18 mm SD=0.10	0.22 mm SD=0.12	0.1–0.2 mm

SD=standard deviation.

DISCUSSION

The failure of the principal components analysis to discriminate any groups is remarkable because the first four components encompass a large part of the total variation. This failure may reflect the absence of identifiable variants or that the taxonomic structure is too complex, with very many variants, to be easily simplified.

A comparison of the contribution of spike characters and vegetative characters to the clustering is interesting. For example, at the three-cluster stage of the whole data set (Fig. 4 & Table 4), the smallest and most distinct cluster (C) exhibits many of the characteristics of *S. ramosissima*, such as being well branched and having a short spike. Cluster A exhibits the character of *S. europaea*, having a long spike and being only moderately branched. Cluster B has the spike characteristics of cluster C and the branching characteristics of cluster A.

In this cluster analysis, the vegetative characters are of equal importance to spike characters. This is not surprising, despite the wide range of phenotypic plasticity reported by Ball & Tutin (1959) in vegetative characters, because many are correlated. As a result much emphasis has been placed on spike characters. Here the 20 best diagnostic characters of the 80 recorded (derived from the cluster analysis) include eleven vegetative measurements. All of the ten best diagnostics of cluster C are vegetative.

Cluster B may, however, represent an ecophene of variant C – a poorly branched variant growing in suboptimal conditions. Tutin (in Clapham *et al.* 1962) notes that "*S. ramosissima*, though typically much branched, bushy and erect" is "often quite unbranched when growing in crowded pure stands or in competition with other plants. Crowding reduces the degree of branching and this is often accompanied by an increase in the length of the terminal spike."

This last point may explain the failure of the principal components analysis to separate the two taxa when it is carried out on the spike data alone.

There is little correlation between clustering and the level on the marsh of the sampling site. At St Peter's there is a separation of individuals of lower from middle marsh sites (Table 4). At Tollesbury this is only on the basis of spike characters. Notably here, it is the well-branched plants which grow in the lower marsh. Itchenor and Canvey show little clustering of sites within each marsh. At Itchenor this is due to the existence of a large proportion of intermediate individuals (Cluster B). At Canvey the clusters are more equally represented.

The lack of stratification of variants as shown by clusters A, B and C is not due to the inclusion of environmentally induced variation in vegetative characters. An examination of the clusters from the analysis of the spike data shows that 45% of cluster D and 48% of cluster E plants come from lower marsh sites.

The cluster analysis of both spike and full data sets does show a remarkable ability to identify local variants. At the seven-cluster stage of the spike data analysis (Fig. 5), between 44% and 75% of individuals of each cluster come from a single site. The only sites not identified are those of Canvey lower marsh, where only 24 individuals were sampled, and Tollesbury lower marsh, where the lower marsh is foreshortened by erosion. In particular, St Peter's lower marsh and Itchenor lower marsh have very distinct local variants. Such local variants are probably the result of the regular self-pollination reported by Dalby (1962). This would encourage the evolution of distinct inbred lines. The hierarchy of clusters at each site may relate to a pattern of familial relationships.

Means and standard deviations of the best cluster diagnostics for each site are shown in Table 6. As can be seen, there is little that can be said in a general way about the variation in particular characteristics between sites. Each site is defined in a different way. The degree of variation present between individuals within each site is assessed by the clustering method which finds 'spherical' minimum variance clusters. The clustering level of the final clustering procedure provides an estimate of the error sum of squares. Tollesbury and Canvey sites which are probably the least well stratified marshes have the greatest range of variant individuals and the least well distinguished variant groups.

TABLE 6. MEANS AND STANDARD DEVIATIONS IN PARENTHESES OF DIAGNOSTIC CHARACTERS FROM SITES WITHIN MARSHES. MEASUREMENTS IN MM

Character	Tollesbury Lower marsh	Tollesbury Middle marsh	St Peter's Lower marsh	St Peter's Middle marsh	Canvey Lower marsh	Canvey Middle marsh	Itchenor Lower marsh	Itchenor Upper marsh
30. Spike length	23.7	34.7	18.7	24.2	30.3	23.0	37.8	27.8
	(5.6)	(8.4)	(5.9)	(7.8)	(8.9)	(8.0)	(6.6)	(7.1)
37. Minimum width	3.0	3.5	2.7	3.1	3.4	3.2	3.7	3.3
of 2nd fertile segment	(0.3)	(0.4)	(0.5)	(0.4)	(0.4)	(0.5)	(0.3)	(0.4)
44. Width of	0.16	0.11	0.28	0.29	0.16	0.20	0.14	0.25
scarious margin	(0.12)	(0.13)	(0.18)	(0.10)	(0.07)	(0.08)	(0.06)	(0.10)
64. Fertile segment	1.4	1.4	1.9	1.5	1.8	1.7	1.5	1.7
width/length	(0.2)	(0.3)	(0.4)	(0.3)	(0.4)	(0.4)	(0.2)	(0.3)
2. Height to 1st	30.2	51.5	9.7	77.3	15.7	22.5	31.6	40.7
branch	(19.1)	(27.0)	(5.3)	(27.4)	(6.2)	(16.7)	(17.0)	(21.5)
55. Internode	7.3	5.2	12.7	2.9	7.9	7.6	5.7	5.6
unevenness	(3.1)	(3.3)	(5.1)	(1.5)	(1.9)	(3.2)	(2.4)	(2.2)
8. Length of basal	60.4	41.4	76.8	38.6	91.8	80.7	63.6	59.9
branch	(36.2)	(36.2)	(30.9)	(27.7)	(46.4)	(52.5)	(36.0)	(34.5)
25. Max. no. of	4.1	2.3	16.7	2.5	14.3	10.4	4.5	7.4
secondary branches	(5.4)	(4.6)	(6.0)	(3.5)	(8.5)	(9.0)	(5.8)	(6.0)
29. Length of longest	0.08	0.32	6.80	0.0	6.00	2.20	0.16	0.90
tertiary branch	(0.57)	(2.26)	(7.0)	—	(7.4)	(5.6)	(1.13)	(3.14)
49. Colour of florets	2.40	1.42	2.70	1.94	1.91	1.74	1.00	1.76
	(0.53)	(0.70)	(0.50)	(0.84)	(0.78)	(0.69)	—	(0.66)
Overall variability Error Sum of Squares from cluster analysis	7.45	7.29	6.75	6.62	3.51	9.90	6.73	6.62
	$\underbrace{\qquad}_{11.90}$		$\underbrace{\qquad}_{17.93}$		$\underbrace{\qquad}_{11.13}$		$\underbrace{\qquad}_{11.55}$	
Sample size	50	50	50	50	24	50	50	49

CONCLUSION

The evidence presented here suggests that by far the most important kind of variation in the *Salicornia europaea* agg. is small scale. Where sites are compared, local variants can be identified, but the variation between sites is not consistent, and thus it is not possible to find a lower marsh and a middle/upper marsh variant in every marsh. In addition, taking the plants as a whole, there is little evidence for the recognition of distinct taxa. Cluster analysis may define clusters which are very similar to the recognized taxa but this is the result of a rather arbitrary division of a more or less continuous spectrum of variation. Such clusters fulfill only one of the four criteria Stace (1980) and Davis & Heywood (1973) cite for the recognition of plant species, i.e. the first of the following:

1. The individuals should bear a close resemblance to one another such that they are always recognisable as members of that group.
2. There are gaps between the spectra of variation exhibited by related taxa.
3. Each taxon occupies a definable geographical area or ecological niche.
4. Sexual taxa should have individuals capable of interbreeding with little or no loss of fertility and there should be some reduction in the level or success (measured in terms of hybrid fertility) on crossing with other taxa.

That the second criterion is not fulfilled is shown by the principal components scatter diagrams. The inability to detect breaks in the spectrum of variation is not due to the inclusion in the analysis of extraneous characters that are very sensitive to environmental variation. Scatter plots of two of the best diagnostic characters show the same complete spectrum of variation (Fig. 6).

These scatter plots also illustrate the failure to fulfill criterion 3. Variants that do exist are not consistently associated with a level on a saltmarsh.

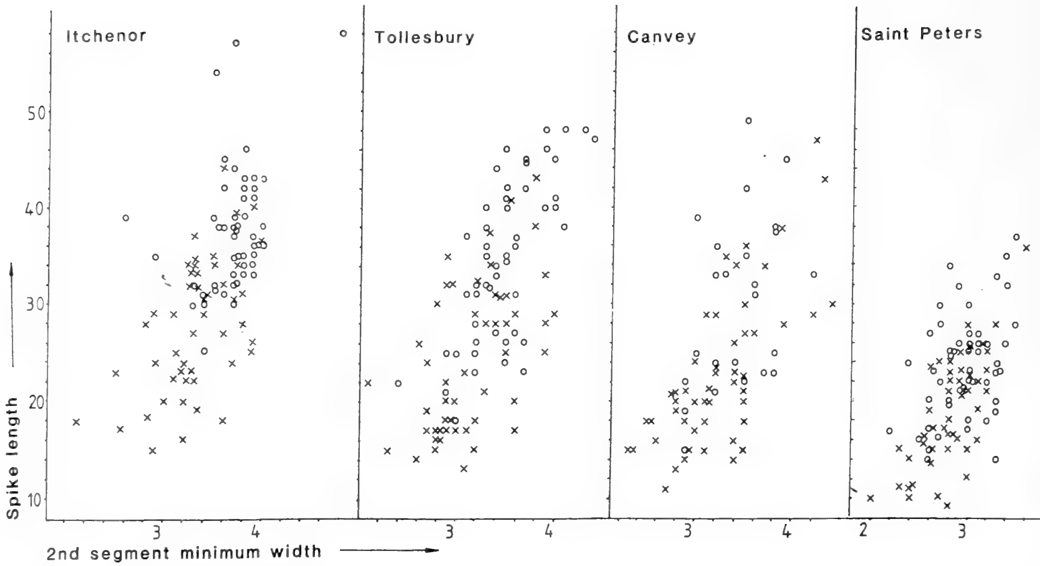


FIGURE 6. Scatter plots of the best cluster diagnostics; spike length and minimum width of 2nd fertile segment (mm). X=upper or middle marsh plants, O=lower marsh plants.

The information presented here provides no evidence for the fourth criterion. No such information is available but the work of Jeffries & Gottlieb (1982) is very suggestive and contradicts our findings. They were able to detect just two electrophoretic morphs which differed consistently in their isozyme pattern for six different enzyme systems. Each 'electromorph' was consistently associated with either lower or upper marsh. More important was the fact that no heterozygotes were detected indicating that the electromorphs do not normally interbreed.

Jeffries & Gottlieb (1982) identify the upper marsh electromorph with *S. ramosissima* and the lower marsh electromorph with *S. europaea*. They further suggest that these two species form, in the British Isles, two distinct homozygous lineages and that the inability to detect any genetic variability within the species throws doubt on previous reports of genetic variants for morphological characters.

If the electrophoretic evidence is taken to its limits all the morphological variation within each species is environmentally induced. The many local variants are then the result of local conditions. Until a proper genetic analysis is carried out this must remain a conjecture. What our work shows is that morphological recognition of the two species is not possible and that it would be better to group them all under *S. europaea* L. The alternative of recognising 'chemical species' is not a practical possibility.

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Hieracium westii, sp. nov.

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ABSTRACT

A new species, **Hieracium westii** P. D. Sell, **sp. nov.**, is described and the account of its discovery set out.

A NEW *HIERACIUM*

Hieracium westii P. D. Sell, **sp. nov.**
TYPUS: By rocky stream, Allt nan Giubhas, Argyll, v.c. 98, GR 27/265.523, c.380 m alt., *P. D. Sell 78/138 & A. G. Kenneth* (Holotypus: **CGE**). Fig. 1.
Ab *H. submuroro* Lindeb. (quo nomen plerumque false cognovitur) caulis foliisque pilosioribus, foliis caulorum numerosioribus, squamis involucri latioribus obtusioribus, ligulis effectis differt, praeterea ab *H. duricipiti* F. J. Hanb. (quid facie simulat) foliis paucioribus erectioribus glaucoviridibus, pedunculis rectis suberectis, capitulis magnioribus, ligulis aureis distinguitur.

Planta phyllopoda. Caulis 28–60 cm altus, gracilis, pilis stellatis dispersis praecipue superne, aliis simplicibus eglanduliferis paucis brevibus et mediocribus pallidis interdum basi nigris ubique, aliis glanduliferis minutis paucis flaviusculis ubique, aliis glanduliferis brevibus paucis obscuris superne vestitus. Folia glaucoviridia, interdum leviter purpureotincta, utrinque et margine pilis simplicibus eglanduliferis brevibus mediocribusque pallidis numerosis, inferne in mediocosto pilis simplicibus eglanduliferis longis paucis, ubique pilis glanduliferis brevissimis flaviusculis dispersis vestita. Folia basalia plerumque pauca, plusminusve erecta; primigena 0.7–2.0 cm longa, 0.5–1.5 cm lata, subrotunda vel late elliptica, obtuso-mucronata, denticulata vel dentata, basi rotundata vel abrupte contracta; cetera 3–10 cm longa, 1.5–5 cm lata, ovata, lanceolata vel elliptica, rotundo-obtusa vel acuta, ordinate dentata, dentibus saepe plusminusve mammiformibus, basi plerumque asymmetrica cuneataque interdum truncata; petioli breves vel mediocres pilis simplicibus eglanduliferis mediocribus vel longis pallidus numerosis vestiti. Folia caulina 1–2 (−3), 1.5–5.5 cm longa, 0.2–2.5 cm lata; inferiora lanceolata anguste acuta vel acuminata, dentata dentibus angustis saepe cuspidatis, sessilia vel petiolis brevibus vel mediocribus semiamplexicaulibus; superiora plerumque bractiformia. Capitula 2–10, 20–30 mm in diametro, bases rotundata; pedunculi recti, suberecti, pilis stellatis numerosis vel aliquantum densis, aliis glanduliferis brevibus et brevissimis obscuris numerosis, aliis simplicibus eglanduliferis brevibus mediocribusque obscuris paucis vel numerosis vestiti; acladium interdum brevissimum. Involucri squamae 10–13 mm longae, 1–1.5 mm latae, atriusculo-virides, interiores marginibus pallidioribus, ante anthesin incumbentes, anguste lineari-lanceolatae, longe contractae ad anguste subacutum vel acutum apicem, interiores fere filamentosae, pilis glanduliferis inaequalibus brevissimis brevibus mediocribusque obscuris numerosis, aliis simplicibus eglanduliferis brevibus mediocribusque obscuris paucis vel numerosis, aliis stellatis interdum paucis versus basem vestitae. Ligulae aureae vel fere aurantiaco-aureae, leviter dentatae, apice pilis simplicibus eglanduliferis brevissimis pallidis numerosis obsitae. Stigmata obscuri. Receptaculi alveoli margine breviter dentati. Cypselae 3.5–4.0 mm longae, obscurae.

Phyllopodous. Stem 28–60 cm, slender, with scattered stellate hairs mainly in the upper part; few, short and medium, pale, sometimes dark-based simple eglandular hairs throughout; few, yellowish, minute glandular hairs throughout and a few, short, dark glandular hairs in the upper

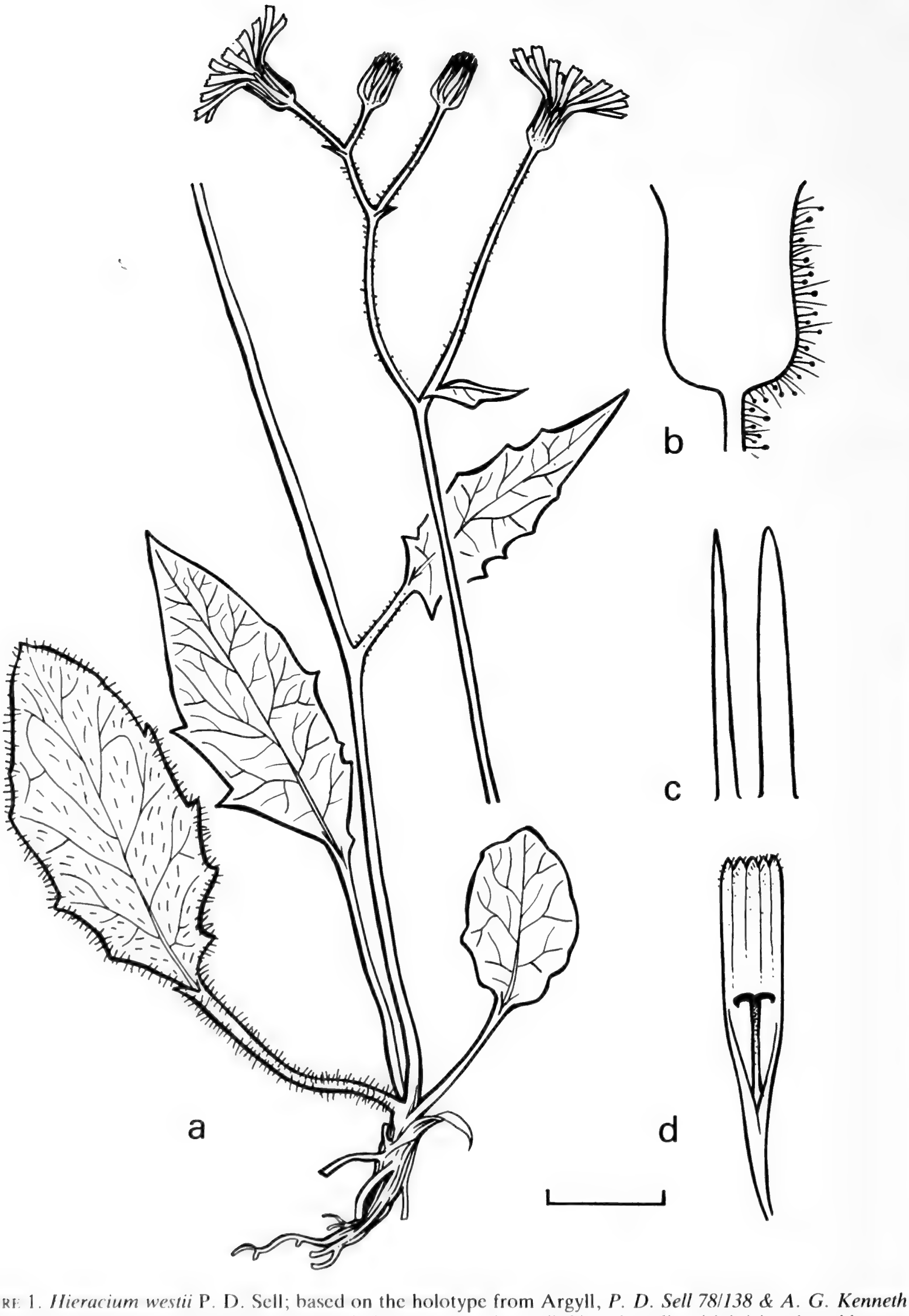

FIGURE 1. *Hieracium westii* P. D. Sell; based on the holotype from Argyll, *P. D. Sell 78/138 & A. G. Kenneth* (CGE): a) whole plant, b) involucre showing indumentum, c) inner (left) and median (right) involucral bracts, d) ligule. Scale bar = a) 30 mm; b, c) 5 mm; d) 7 mm

part. Leaves bluish-green, sometimes slightly purple-tinted, with numerous short and medium, pale simple eglandular hairs on both surfaces and the margins with a few long ones on the midrib beneath, and scattered, very short, yellowish glandular hairs throughout. Basal leaves usually few, more or less erect; primordial 0.7–2.0×0.5–1.5 cm, subrotund or broadly elliptical, obtuse-mucronate at apex, denticulate or dentate, rounded or abruptly contracted at base; later 3–10×1.5–5 cm, ovate, lanceolate or elliptical, rounded-obtuse or acute at apex, regularly dentate, the teeth often more or less mammiform, usually asymmetrical and cuneate, sometimes truncate at base; petioles short or medium, with numerous medium or long, pale simple eglandular hairs. Cauline leaves 1–2 (−3), 1.5–5.5×0.2–2.5 cm, lower lanceolate, narrowly acute or acuminate at apex, dentate, the teeth usually rather narrow and often cusped, with short or medium, semiamplexicaul petioles, or sessile, upper leaf usually bract-like. Capitula 2–10, 20–30 mm in diameter, base rounded; peduncles straight and suberect, acladium sometimes very short, with numerous or rather dense stellate hairs, numerous short and very short, dark glandular hairs, and few to numerous, short and medium, dark simple eglandular hairs. Involucral bracts 10–13×1–1.5 mm, blackish green, the inner with paler margins, incumbent in bud, narrowly linear-lanceolate, long tapering to a narrow subacute to acute apex, the inner almost filamentous, with numerous, unequal, very short, short and medium, dark glandular hairs, few or numerous, short and medium, dark simple eglandular hairs and sometimes a few stellate hairs towards the base. Ligules golden or nearly orange-yellow, rather shallowly dentate, with numerous, very short, pale simple eglandular hairs at apex. Stigmas discoloured. Margins of receptacle pits shortly dentate. Achenes 3.5–4.0 mm, dark.

I had hoped to celebrate Dr Cyril West's hundredth birthday by describing this new species after him, but he died on 25th March 1986, aged 98. Almost the whole of his thirty-odd years of retirement had been devoted to the study of the genus *Hieracium*. Our last piece of work together was to compare in detail the British plants that had been called *H. submurorum* Lindeb. with those from Scandinavia. We decided the British plant was quite distinct and wrote a detailed description, but never published it. It seems appropriate that this species should bear his name.

Hieracium westii was first discovered by E. S. Marshall by a streamlet in Cam Glen, Glen Etive, Argyll, v.c. 98, on 27th June 1888. The sheet in Marshall's herbarium (**CGE**) bears the note in his handwriting "The first discovery of this good 'species' in Britain". Two more sheets with the same date are labelled "stream above 'Tighe Craige Duibhe' Clach Leathad (say 1800 feet) near Kingshouse, Argyll". They had been determined by Lindeberg as "Proximum *H. submurorum*" in 1890 and were confirmed by Elfstrand in 1894. One of these is also labelled "First known British specimens". Seeds from near Kingshouse were grown by Marshall and there are cultivated specimens in his herbarium collected in 1890 and 1891. He collected it again from a mountain stream near Kingshouse on 17th July 1889. A cultivated specimen of Marshall's in the Bickham herbarium (**CGE**) is labelled "root from Allt Giubhas". Hanbury (1892) writes "This was collected in some quantity by the Rev. E. S. Marshall and myself, on the mountains round Kingshouse, Argyll, our specimens agreeing well with the type No. 112, *Hierac. Scand. Exsicc.*". In Hanbury's *Illustrated monograph of the British Hieracia* it is beautifully depicted on plate 21, but only the Argyll plant in the list of localities given is referable to it. The illustration was based on a Clach Leathad plant supplemented by a cultivated specimen. A cultivated specimen in herb. Hanbury (**BM**), said to have been used for this purpose, could not possibly have supplied the inflorescence, but some of the leaves may possibly have been used. It is not absolutely clear how many different localities these early botanists saw it in, but there seem to have been at least two.

It does not appear to have been seen again until rediscovered by John Raven on 14th July 1953 at Allt nan Giubhas where it has since been examined by Cyril West, Beverley Miles, Archie Kenneth and myself (all in **CGE**). It grows in crevices on rocks and boulders, and beside the stream in association with *Anthoxanthum odoratum, Calluna vulgaris, Deschampsia cespitosa, Luzula sylvatica, Potentilla erecta, Ranunculus acris, Solidago virgaurea, Sphagnum* sp., *Succisa pratensis* and *Vaccinium myrtillus*. The stream of Allt nan Giubhas is one of the finest localities for alpine and subalpine hawkweeds in the whole of Scotland, containing in some abundance *H. anfractiforme, H. callistophyllum, H. dasythrix, H. dewari, H. duriceps, H. eximium, H. gracilifolium, H. holosericeum, H. lingulatum, H. marshallii, H. memorabile, H. pictorum, H. pseudanglicum, H. subhirtum, H. tenuifrons* and *H. vulgatum* as well as at least one other undescribed species.

Hieracium westii is characterized by its bluish-green, suberect, toothed leaves, few capitula on straight suberect peduncles, dark involucral bracts clothed with numerous, unequal, dark, glandular hairs and few to numerous, dark, simple eglandular hairs and golden to nearly orange ligules (Fig. 1).

ACKNOWLEDGMENTS

I am grateful to N. K. B. Robson for checking the Latin description, A. O. Chater for reading and commenting on the text, and Tim Sell for drawing the illustration.

REFERENCE

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Hieracium pellucidum Laest., *H. lucidulum* (A. Ley) Roffey and *H. asteridiophyllum* P. D. Sell & C. West

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ABSTRACT

The taxonomic history and distribution of *Hieracium pellucidum* Laest. and *H. asteridiophyllum* P. D. Sell and C. West (Asteraceae) are discussed and their nomenclature is set out.

INTRODUCTION

When Dr C. West and I described *H. asteridiophyllum* (Sell & West 1955) we gave no explanation of our treatment of, and its relationship to, the allied *H. pellucidum*. *H. asteridiophyllum* can be distinguished from *H. pellucidum* by its having simple eglandular as well as glandular hairs on the involucral bracts and stellate hairs on the underside of the leaves. This paper discusses the taxonomic history of these two species, outlines their distribution in Britain, and sets out their nomenclature.

HISTORY

H. pellucidum was described by Laestadius (1824) and there is a specimen in the Stockholm herbarium (**S**) labelled "Ångermanland ad Tasjo, 1824, *Laestadius*", which appears to be the holotype. Whether the date is that of the actual collection is unsure, but in those days it was possible to get a new species published in the same year that it was collected. The volume in which it was published appeared in two parts, both of which are dated 1824 but without a precise day or month. *H. pellucidum* was in the first part. In my opinion, the Scandinavian plants described as *H. pellucidum* are identical with those found in the British Isles. There is a good description in Pugsley (1948); the Scandinavian distribution is given by Samuelsson (1954), and the distribution in the British Isles by Perring (1968).

In both Scandinavia and the British Isles, any sizeable population of *H. pellucidum* seems to contain plants with two different leaf shapes. In one the leaves are large, ovate in outline and somewhat pointed. In the other they are smaller, more elliptical and rounded at the apex. Plants occur also that are more or less intermediate. Scandinavian hieraciologists include both these variants in *H. pellucidum* and I would agree with them. The Laestadius specimen is of the pointed leaved variant.

The Rev. Augustin Ley grew two variants (but perhaps not the two mentioned above) side by side for six or seven years, and considered that they remained distinct. As well as the leaf difference, he thought that the round-leaved plant had smaller capitula, which formed a somewhat umbellate inflorescence, and named them *H. murorum* var. *lucidulum* (Ley 1900). *H. pellucidum* was regarded as another variety of *H. murorum*. Although it is quite clear from the description what Ley intended, there is some difficulty in typifying var. *lucidulum*. All the specimens in his herbarium (**CGE**) cited under var. *lucidulum* are still labelled "var. *pellucidum*", "*H. murorum* var.", or in one case "*H. murorum lucentius* var. nov.". Later specimens, labelled *H. murorum* var. *lucidulum* or *H. lucidulum*, are the same plant. Fortunately Ley says "Sent out by me through the London Bot. Exchange Club in 1896, from Llangadoc, as var. *pellucidum* Laestad." In his herbarium is a sheet of this gathering bearing two complete plants, a stem without basal leaves, and a stemless basal rosette. The plants are in accord with the original description and show well the subumbellate inflorescence. I designate this sheet as the lectotype of *H. murorum* var. *lucidulum* A. Ley. In Ley's herbarium there are no specimens labelled either *lucidulum* or *pellucidum* that are *H. asteridiophyllum*.

W. R. Linton (1905) transferred var. *lucidulum* to *H. pellucidum*. His description does not differ much from Ley's, but specimens collected by Ley in 1900, and others by E. F. and W. R. Linton in 1897 from Craig Cille [Craig y Cilau], Brecon, were both distributed as *H. murorum* var. *lucidulum* in their "Set of British Hieracia no. 139" and are *H. asteridiophyllum*.

Williams (1902) transferred var. *lucidulum* to *H. silvaticum*. His description is more or less that of Ley, but he cites the Lintons' "Set no. 139", which is *H. asteridiophyllum*. Ley (1909) says "It appears that the plants we have been accustomed to call *H. pellucidum* Laestad. in Britain, and some which have been so named by great Scandinavian authorities, are now mostly placed under *H. serratifrons* Almq., and that the very distinct plant we have been naming *lucidulum* Ley is the true *H. pellucidum* Laestad." This is true in that many of Ley's specimens of *pellucidum* belong to what I call the *H. exotericum* agg. It is not known what the plants were which Ley grew to compare with var. *lucidulum*. Zahn (1921) raised var. *lucidulum* to a subspecies of *H. murorum*, but his description, clearly based on the Lintons' "Set no. 139", is of *H. asteridiophyllum*. Roffey (1925) raised var. *lucidulum* to the rank of species, not, I think, because he knew anything about it, but because Zahn had called it a subspecies. Druce (1928) also had it as a species. Pugsley (1948) kept separate what he cited as *H. pellucidum* var. *lucidulum* W. R. Linton emend., with the references "*H. pellucidum* var. *lucidulum* W. R. Lint. *Brit. Hier*. 43 (1905) pro min. parte; *H. pellucidum* Ley in *Jour. Bot.* xlvii 13 (1909), pro min. parte; and *H. murorum* subsp. *lucidulum* Zahn, l.c. 318 (1921)". Pugsley's description of *H. pellucidum* var. *lucidulum* is clearly that of *H. asteridiophyllum*. Of the specimens cited by Pugsley (1948), those from Craig y Cilau are *H. asteridiophyllum*, the Pwll Byfre plant is *H. discophyllum* P. D. Sell & C. West, and the Ingleton specimen I have not seen.

DISTRIBUTION

H. pellucidum is one of several *Hieracium* species which are widespread in Scandinavia and absent from Scotland and Ireland, but which appear in some quantity on the limestone cliffs of northern England, Derbyshire and Wales.

H. asteridiophyllum is endemic to the cliffs of Craig y Cilau just south-west of Crickhowell, Brecon (v.c. 42) (GR 32/181.166 to GR 32/190.156), incorrectly called Craig Cille by A. Ley. They are mostly in a National Nature Reserve and consist of a shallow north-east-facing scarp of tiered cliffs and steep slopes, with much scree, at an altitude of 275–460 m. It is one of the largest exposures of upland limestone in south Wales. In 1975 Lynne Farrell and I did a census of *Hieracium* (and *Sorbus*) on this cliff, and saw 460 plants of *H. asteridiophyllum*. We examined three levels of cliff; 387 plants were in the lower section, only one was seen in the middle part, and 72 in the upper part. Although occurring along the whole length of the cliff, most plants were at the northern end. *H. pellucidum* is also on the cliff, but we saw only 24 plants, again mainly at the northern end.

NOMENCLATURE

HIERACIUM PELLUCIDUM Laest. in *Kungl. Svenska Vet.-Akad. Handl.*, **1824**: 172 (1824). TYPE: Ångermanland ad Tasjo, Sweden, 1824, *L. L. Laestadius* (Holotype: **S**).

H. murorum var. *lucidulum* A. Ley in *J. Bot., Lond.*, **38**: 3 (1900) (TYPE: River side rocks, Llangadoc, Carmarthenshire, 1st June 1896, *A. Ley* (Lectotype: herb. Ley in **CGE**).

H. silvaticum var. *lucidulum* (A. Ley) Williams, *Prodr. Fl. Brit.*, 137 (1902).

H. pellucidum var. *lucidulum* (A. Ley) W. R. Linton, *Brit. Hier.*, 43 (1905).

H. murorum subsp. *lucidulum* (A. Ley) Zahn in Engler, *Pflanzenreich*, **76** (IV. 280): 318 (1921) quoad basionymum exclud. descript.

H. lucidulum (A. Ley) Roffey in F. J. Hanb., *London Cat. Brit. Pl.*, 11th ed., 27 (1925).

HIERACIUM ASTERIDIOPHYLLUM P. D. Sell & C. West in *Watsonia*, **3**: 233 (1955). TYPE: Daren Cilau (Craig Cille), Brecon, 1952, *C. West* (Holotype: **CGE**).

H. murorum subsp. *lucidulum* sensu Zahn in Engler, *Pflanzenreich*, **76** (IV. 280): 318 (1921) quoad descript. exclud. basionymum.

H. pellucidum var. *lucidulum* sensu Pugsley in *J. Linn. Soc. Lond. (Bot.)*, **54**: 141 (1948) quoad descript. et pl. Craig Cille.

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The history and nomenclature of Thomas Edmondston's endemic Shetland *Cerastium*

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ABSTRACT

A bibliographic history of the endemic Shetland *Cerastium* currently known as *C. arcticum* Lange subsp. *edmondstonii* (H. C. Watson) Á. & D. Löve is given, together with some biographical notes on Thomas Edmondston. The correct name for the species is shown to be *C. nigrescens* (H. C. Watson) Edmondston ex H. C. Watson, which includes subsp. **nigrescens** endemic in Shetland and subsp. **arcticum** (Lange) Lusby, **comb. nov.**, occurring in Wales and mainland Scotland and widespread in northern Europe.

INTRODUCTION

During work on a forthcoming Flora of the Shetland Islands, one of the present authors (R. C. Palmer) found cause to query the correct name and authorship of the *Cerastium*, endemic to the Shetlands, variously known by the epithets *edmondstonii* and *nigrescens*. On further investigation with two others (R. K. Brummitt & D. H. Kent) it became obvious that the citation in *Flora Europaea* (Jalas 1964) of *C. nigrescens* Edmondston ex H. C. Watson as a synonym of *C. arcticum* Lange subsp. *edmondstonii* (H. C. Watson) Á. & D. Löve was suspect. The specific name *C. arcticum* was not published until 1880, and since H. C. Watson died in 1881 at the age of 77 the likelihood of his having validated *C. nigrescens* after the publication of *C. arcticum* seemed remote. Further enquiries revealed a recent unpublished thesis by the fourth present author (Lusby 1984) investigating the same problem and reaching similar, but not identical, conclusions. Our joint findings are here merged into one paper.

Examination of the literature has revealed several incorrect nomenclatural assumptions and numerous overlooked important bibliographical details in accounts by earlier authors, despite several papers having been devoted to the taxonomy and nomenclature of this group of species. We have here tried to bring together the historical details and recall a little of the remarkable Edmondston, as well as to resolve the nomenclature of the plant. The several bibliographic references given in the text below instead of in the References at the end are to notes published anonymously.

Mr P. D. Sell (Cambridge) has very generously made available his own extensive notes on the species concerned, and has encouraged us to publish our findings while reserving his own judgment on the taxonomy of the group.

EDMONDSTON AND THE DISCOVERY OF THE SHETLAND *CERASTIUM*

Thomas Edmondston was born in the Shetland Islands on 20th September 1825, the eldest son of the medical practitioner on the island of Unst. Although delicate early in life, he soon showed himself to have an extraordinarily quick and retentive memory, and a predilection for natural history from the age of four (Seeman 1853: 67–78). In 1837, at the age of eleven, he compiled a remarkably competent catalogue of the plants of Unst, listing 174 species by their Latin names. On September 3rd that year he had the good fortune to meet William Dawson Hooker, elder son of W. J. Hooker and brother of J. D. Hooker, who was returning from a naturalists' expedition to northern Norway when his ship sought shelter from bad weather at Baltasound in Shetland. Hooker was entertained there by the Edmondstons, and noted Thomas as "a particularly intelligent boy, and passionately fond of Natural History" (W. D. Hooker 1839: 110–111). Later Dr Edmondston sent a copy of Thomas's manuscript catalogue to W. J. Hooker, noting that the only assistance he had had was from two books, Willdenow's *Introduction* and McGillivray's edition of Withering, and it was eventually printed by W. D. Hooker in the second edition of his *Notes on Norway* (Edmondston 1839). This included a reference (p. 114) to "*Cerastium alpinum*; very rare, on serpentine; June."

In 1837, Dr Gilbert McNab visited Unst and was shown the *Cerastium* by the young Edmondston. McNab sent material to the Botanical Society of Edinburgh, where it was exhibited and commented on by the President, Dr Robert Graham, and in a report of the meeting in *Annals of Natural History*, **1**: 406 (1838), Graham's determination of the plant as '*Cerastium latifolium* var.' is recorded.

At the age of fifteen, Edmondston published a list of plants observed in the Shetland Islands (Edmondston 1841), including the first record of *Arenaria norvegica* Gunn. from the British Isles and recording '*Cerastium latifolium*' from near Baltasound. In the same year, he visited the Scottish mainland, where he saw full-grown trees for the first time, and was appointed Assistant Secretary of the Edinburgh Botanical Society (Jackson 1888). By March 1841, Edmondston was also already corresponding with C. C. Babington of Cambridge about his Shetland *Cerastium*, commenting in May the same year that "a reference to the Linnaean herbarium would settle any doubts" (Mrs Edmondston 1868: 117). In March 1843, at the age of seventeen, with the support of Babington he published a paper in *The Phytologist* (Edmondston 1843a) on the taxonomy of alpine and arctic species of *Cerastium*, drawing attention particularly to the Shetland plant, which he referred to *C. latifolium* L. He followed Bentham's opinion, quoted in Lindley (1829: 51), by referring the Scottish and Welsh mountain plants to *C. alpinum* L., in which a var. *piloso-pubescens* Benth. was also recognized.

Shortly afterwards, H. C. Watson, one of the leading amateur botanists of the day, replied in the May issue of the same journal, disagreeing with Edmondston's taxonomy and considering the Shetland plant "in all likelihood a mere form or variety of the same species as the *C. latifolium* (of British authors) found in many of the Highland mountains" (Watson 1843a). In the August issue Edmondston responded spiritedly, maintaining that the Shetland plant was distinct (Edmondston 1843b), but in the following issue Watson replied again saying that after consulting the Linnean herbarium he considered that Edmondston had confused the characters of the taxa (Watson 1843b). Watson here emphasized seed characters as the best means of distinguishing the species, but the following year (Watson 1844) he noted that the names of his packets had been switched.

In 1844 Edmondston sent good herbarium specimens bearing live seeds to Watson, and to other members of the Botanical Society of London, under the name "*Cerastium nigrescens* Edmond.". Specimens are still preserved in the Watson herbarium at Kew, together with some prepared in 1845 and 1846 from plants grown by Watson from the seeds sent by Edmondston. However, in the first edition of the *London Catalogue of British Plants*, published by the Botanical Society of London in 1844, the plant appears under the name *C. latifolium* L. b. *edmondstonii*, a *nomen nudum*, without any authority given but almost certainly at Watson's instigation (W. J. Hooker 1844: 294; Allen 1983). This seems to be a sign of weakening in Watson's opposition to

Edmondston's view that the Shetland plant was taxonomically distinct from mainland plants, and in *The Phytologist* of March the next year (Watson 1845) he grudgingly acknowledged that "Mr Edmondston's specimens are distinguishable from my other wild specimens by their shorter capsules and usually (not constantly) broader leaves; which are the only characters to distinguish them, even as a mere variety, from the species of the Highland mountains". He adopted the name "*Cerastium latifolium* (Linn.) var. *Edmondstonii* (Lond. Cat.)" in the title of the paper, and this brief description would be sufficient to validate this name. The note was dated 12th February 1845 and, judging by the average time of several weeks between submission of articles and their appearance in *The Phytologist*, it is likely that publication was towards the end of March.

Strangely enough, however, two to three pages later in the same journal (*The Phytologist*, **2**: 95–96, 1845), in a report of the proceedings of the Botanical Society of London for 7th February 1845 published by G. E. Dennes, reference was made to the specimens of the Shetland *Cerastium* presented by Edmondston to the Society, noting that they were labelled "*Cerastium nigrescens* Edmond. in Shetland Fl. ined." and that "It would thus seem that Mr Edmondston has changed his opinion regarding its specific identity with the Linnaean species". This was considered by Druce (1908, 1911, 1922) to constitute validation of the name, but we agree with Marshall (1911) that it is not validly published here. The author, Dennes, did not accept the name (*International Code of Botanical Nomenclature*, Art. 34.1a) and went on to say that it may be doubted whether Edmondston's specimens can be distinguished from the Highland and Linnaean *C. latifolium*.

However, in 1845 Edmondston's *Flora of Shetland* was also published (Edmondston 1845). Jackson (1888) referred to it as published in Spring 1845, and it seems likely that it was published in February or the first week of March. Neither of the notes in the March issue of *The Phytologist* referred to above (both written in mid February) made any mention of it, but a letter by Edmondston himself to his uncle dated 8th March 1845, reproduced in the biography published by his mother (Mrs Edmondston 1868: 222), refers to his book as "published at last". On p. 29 of his *Flora*, Edmondston included "*Cerastium latifolium β Edmondstonii*. (London Botanical Society's Catalogue of British Plants)", with "*C. latifolium* Edmondston in *Phytologist* p. 498" and "*C. nigrescens* Edmonds. MSS." in synonymy followed by a detailed description of the Shetland plant. This constitutes validation of the name *C. latifolium* var. *edmondstonii* (*I.C.B.N.* Art. 35.3), and apparently precedes Watson's publication of the same name (see above) by about a month. In the preface to his *Flora*, however, on p. xv Edmondston wrote "On the Serpentine hills near Baltasound grows *Arenaria Norvegica* and *Cerastium nigrescens* . . .". Druce (1922) suggested that the preface was written after the text, but since Edmondston wrote of the plant in question on p. 30 "Mr Watson, after an investigation of numerous specimens, still considers this plant as not truly distinct from *C. latifolium*, and from deference to his authority I give up the point . . ." this seems questionable. Since the name *C. nigrescens* was clearly not accepted in the *Flora* it cannot now be considered to have been validly published there. Thus two different epithets, *edmondstonii* and *nigrescens*, became established in the literature almost simultaneously for the same plant between 1844 and 1845, but in neither case was a specific binomial under *Cerastium* validly published. Furthermore, Edmondston himself seemed unable to make up his mind which to use.

Having gained the friendship of the leading Scottish professionals such as W. J. Hooker and J. Hutton Balfour and established for himself a reputation of being one of the most brilliant young botanists in the country, Edmondston was appointed Professor of Botany at Glasgow in January 1845 at the age of nineteen. A few months later, however, he took the fateful decision to take part in an expedition to the Pacific and California as naturalist aboard *H.M.S. Herald* (see *The Phytologist*, **2**: 185, 1845) which he joined on 21st May 1845. After sailing via Buenos Aires and the Falkland Islands, the ship rounded Cape Horn and visited Chile and the Galapagos Islands before calling at Sua Bay in Ecuador. Here, on the evening of 24th January, as Edmondston was boarding a small boat to re-join ship, a man in front of him caught the lock of a rifle in his trouser leg and accidentally fired it, shooting Edmondston in the head and killing him instantly (Seemann 1853: 66). His death was announced in *The Phytologist*, **2**: 580 (1846). This tragic loss at the age of twenty of a man surely otherwise destined to become one of the great botanists of the nineteenth century meant that the Shetland *Cerastium* was left in a position of doubt and uncertainty which has persisted to the present day.

LATER TAXONOMIC HISTORY

The subsequent taxonomic history of the Shetland plant reveals many varying opinions. Although the name *C. latifolium* L. had been commonly applied to British plants, Lange (1880) regarded this as a species of the southern Alps only, and described the widespread northern taxon as *C. arcticum* Lange. He did not actually mention the Shetland plant, but his circumscription of his new species was such that it could well have included it. Beeby (1887) accepted Lange's species and referred the Shetland plant to it as *C. arcticum* var. *edmondstonii* (H. C. Watson) Beeby. Murbeck (1898) apparently adopted a similar species concept but called the species *C. edmondstonii* (Wats.) Murb. & Ostenfeld, with *C. arcticum* Lange in synonymy, though failing to quote any specific name earlier than *C. arcticum* or to explain why the epithet *edmondstonii* was considered to have priority. Asplund (1918) discussed the status of *C. edmondstonii* but regarded it as a synonym of *C. arcticum* Lange. Ostenfeld (1920) adopted a specific concept similar to that of Murbeck, but changed the name of the species to *C. nigrescens* Edmondston on the false assumption that Edmondston had validated the specific name in his *Flora of Shetland* in 1845. Hylander (1945: 148–149), however, in a detailed nomenclatural analysis, accepted the name *C. edmondstonii* to cover the widespread species.

In the *Flora of the British Isles*, Clapham (1952) called the species *C. edmondstonii*, with "*C. arcticum* auct., vix Lange" in synonymy, distinguishing the Shetland plant as "var. *nigrescens* Edmondston"; this must be incorrect since the type of both the specific and varietal names must be the Shetland plant. A note by Brett (1953) argued for *C. arcticum* as the correct name, but failed to consider any of the bibliographical details. Löve & Löve (1956) also reverted to the specific name *C. arcticum* and recognized within it a widespread subsp. *edmondstonii*, including not only the Shetland plant but also plants from the Faeroes and eastern Iceland, and then distinguished the Shetland plant within this as var. *nigrescens*. Hultén (1956) with some reservation regarded the Shetland plant as specifically distinct, calling it *C. edmondstonii* (Watson) Murb. & Ostenf., and referred the Scottish mainland plants to *C. arcticum* Lange var. *arcticum* and var. *alpinopilosum* Hultén. In the second edition of the *Flora of the British Isles*, Clapham (1962) also regarded the Shetland plant as a species endemic there, but under the name *C. nigrescens* Edmondst. ex H. C. Watson, with *C. edmondstonii* in synonymy, and called the widespread mainland and arctic plant *C. arcticum* Lange. Jalas (1964), in *Flora Europaea*, adopted the same nomenclature as Löve & Löve but restricted subsp. *edmondstonii* to the Shetland plant, an opinion with which we tentatively agree. Böcher (1977), however, while dividing *C. arcticum* into three subspecies, sank *C. edmondstonii* without trace into *C. arcticum* subsp. *arcticum*, commenting that the Greenland plant is inseparable from that from Iceland and the Faeröes, which ignores the fact that the type of *C. edmondstonii* must be from Shetland.

NOMENCLATURE

The question which now remains is that of the correct name for the species when the Shetland plant is included in the widespread species. The name *C. arcticum* dates only from 1880, while the epithets *nigrescens* and *edmondstonii* have been in the literature considerably longer. Was neither adopted at specific rank in a valid name before 1880?

The binomial *C. edmondstonii* is given in *Index Kewensis, Suppl.* **5**, 1921, as first validated by Murbeck & Ostenfeld in Murbeck (1898) and this appears to be correct. The original volumes of *Index Kewensis* in 1893 gave *C. nigrescens* as having been validated by Syme in *English Botany*, 3rd ed., **2**: 87 (1864), but this was corrected in *Supplement* **12** in 1959 to H. C. Watson, *Cybele Britannica*, **1**: 233 (1847). However, although Watson here gave a binomial *C. nigrescens*, he numbered it 197b under his 197 *C. latifolium*, commenting that "I therefore describe its distribution apart from that of *C. latifolium*, though still inclining to hold it a variety of the Linnean species". It is clear that Watson did not recognize it at specific rank and so cannot be held to have validated the specific name here. However, despite the fact that he used a binomial form, we may accept that he validated here the name *C. latifolium* var. *nigrescens* (see *I.C.B.N.*, Art. 24.4). The publication by Syme in 1864, referred to above, clearly accepted *C. latifolium* var. *nigrescens*, and although the binomial "*C. nigrescens* Edmondston mss" was given beneath, it is not valid since it is in synonymy only (*I.C.B.N.* Art. 23.1 (d)).

However, examination of Watson's many other works reveals that he did in fact publish the binomial *C. nigrescens* in his first supplement to the *Cybele Britannica* (Watson 1860). It appears on p. 81 in a list of species simply as *Cerastium nigrescens*, and, despite the fact that no author citation was given, it is clearly referable back through the title of the book to the name used in his original work of 1847 in which he validated the name *C. latifolium* var. *nigrescens*. Strangely, there might be some doubt whether the book is effectively published under the requirements of the *International Code*, for at the foot of the title page it reads "Printed for private distribution". A notice on p. 2, however, says that it "will be sent to all the provincial botanists of Britain whose present addresses are known to the author. . . . As the author cannot bind himself certainly to proceed with the Supplement . . . he feels that it cannot properly be made a published work". 'Publication' in Watson's sense meant commercial publication, whereas in a botanical sense "Publication is effected . . . by distribution of printed matter (through sale, exchange or gift) to the general public . . ." (*I.C.B.N.* Art. 29.1). The latter is clearly fulfilled by Watson's *Supplement*, and this publication must be taken as validating the specific combination.

Watson did not produce any more supplements to his *Cybele Britannica*. However, in his later *Compendium of the Cybele Britannica*, he first (Watson 1868: 126) sank *C. nigrescens* completely into *C. latifolium*, but later (1870: 492) gave it as a segregate taxon of his aggregate species *latifolium*, in the form "*Cerastium* (*latifolium*?) *nigrescens*, Edm.". His comments in his introduction (Watson 1870: 462–463) that "segregates . . . can be distinguished from almost all the rest, the non-indigenous plants, by their names being given in triplets, the name of the aggregate species being inserted between the generic name and the distinctive name of the segregate . . . It is at the reader's own choice to receive that distinctive name as varietal or as specific, in accordance with his own views in each separate instance" make it clear that he did not clearly adopt specific rank for *nigrescens* here. This cannot, however, detract in any way from his unambiguous publication of a specific binomial in his 1860 supplement, and it is clear that the name *C. nigrescens* (H. C. Watson) Edmondston ex H. C. Watson predates *C. arcticum* Lange by 20 years and must be taken up as the correct name for the latter. Unfortunately then, following *Flora Europaea* taxonomy, the widespread taxon hitherto known as *C. arcticum* subsp. *arcticum* requires a new combination.

Correct names of British taxa and synonymy relevant to Britain are given below. Since it is obvious from the above that *nigrescens* and *edmondstonii* were essentially alternative epithets for the same taxon, we have deliberately chosen the same lectotype for both, making all names involving either epithet homotypic.

CERASTIUM NIGRESCENS (H. C. Watson) Edmondston [*Fl. Shetland*, xv, 29 (1845), *in synon.*] ex H. C. Watson, *Part First Suppl. Cyb. Brit.*, **1**: 81 (1860). TYPE: Shetland, Baltasound, Aug. 1844, *Edmondston* (Lectotype: **K**, in herb. H. C. Watson; chosen here).

C. latifolium var. *edmondstonii* [anon. in *Lond. Cat. Br. Pl.*, 2 (1844) *nom. nud.*] Edmondston, *Fl. Shetland*, 29 (Feb. or early March 1845); H. C. Watson in *Phytologist*, **2**: 93 (later March 1845). TYPE: as for *C. nigrescens* above, chosen here as lectotype.

C. latifolium var. *nigrescens* H. C. Watson, *Cyb. Brit.*, **1**: 233 (1847).

C. alpinum var. *edmondstonii* (Edmondston) Hook.f., *Stud. Fl. Br. Isl.*, 3rd ed., 60 (1884).

C. arcticum var. *edmondstonii* (Edmondston) Beeby in *Scott. Nat.*, n.s., **14**: 24 (1887).

C. edmondstonii (Edmondston) Murb. & Ostenf. in *Bot. Notiser*, **1898**: 246 (1898).

C. arcticum forma *nigrescens* (H. C. Watson) Druce in Moss, *Cambr. Br. Fl.*, **3**: 48 (1920).

C. edmondstonii var. *nigrescens* (H. C. Watson) Clapham in Clapham, Tutin & Warburg, *Fl. Br. Isl.*, 299 (1952).

C. arcticum subsp. *edmondstonii* (Edmondston) Á. & D. Löve in *Acta Horti Gothoburg.*, **20**: 110 (1956).

C. arcticum var. *nigrescens* (H. C. Watson) Á. & D. Löve *loc. cit.* (1956), *nom. inval.*, without proper basionym reference.

a. subsp. *NIGRESCENS*

C. latifolium var. *acutifolium* Edmondston, *Fl. Shetland*, 30 (1845). Described from Shetland, no specimen traced.

C. nigrescens var. *acutifolium* (Edmondston) Druce in *Rep. botl Soc. Exch. Club Br. Isl.*, **6**: 476 (1922).

b. subsp. **ARCTICUM** (Lange) Lusby, **comb. nov.**

C. arcticum Lange, *Fl. Danica*, **17** (50): 7 (1880). TYPE: Greenland, *Vahl* (Lectotype: see Hultén (1956: 459), not seen).

C. arcticum subsp. *arcticum* Á. & D. Löve in *Acta Horti Gothoburg.*, **20**: 110 (1956).

C. latifolium var. *compactum* Syme in Sowerby, *English Botany*, 3rd ed. **2**: 87 (1864). Type not traced.

C. arcticum var. *alpinopilosum* Hultén in *Svensk Bot. Tidskr.*, **50**: 450 (1956). Type not stated.

C. latifolium var. *smithii* Syme in Sowerby, *English Botany*, 3rd ed., **2**: 87 (1864) is a superfluous illegitimate name for *C. atratum* Lap. var. *piloso-pubescens* Benth., *Cat. Pl. Indig. Pyren. Bas Languedoc*, 70 (1826) and must be typified by a plant from the Pyrenees. The latter name was applied to British plants, presumably in error, by Lindley (1829) apparently on the advice of Bentham.

A question may arise concerning the authorship of the name *C. nigrescens* given above. As noted, Edmondston first proposed this name but did not validate it. The first validly published name including the epithet *nigrescens* was *C. latifolium* var. *nigrescens* published by H. C. Watson in 1847, and because this combination was never proposed by Edmondston it seems desirable to attribute it only to H. C. Watson (cf. Laundon 1985). The specific binomial was proposed by Edmondston in manuscript, and was validly published by H. C. Watson in 1860. Hence the citation given above of *C. nigrescens* (H. C. Watson) Edmondston ex H. C. Watson. It may well seem paradoxical that according to the present rules of nomenclature the epithet *nigrescens*, which was first proposed by Edmondston, has to be attributed to Watson as the first validating author, while the epithet *edmondstonii*, which was applied to the same plant almost simultaneously by Watson, has to be attributed to Edmondston himself! Such is the result of the bibliographic mix-up between the two men.

In our discussion we have omitted reference to the var. *acutifolium* described by Edmondston in his *Flora*, though it is included in the synonymy above. The taxonomic status of this will be the subject of further research by one of us (P. S. Lusby).

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Typification of *Festuca rubra* L., *F. ovina* L. and *F. ovina* var. *vivipara* L.

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ABSTRACT

Festuca rubra L., *F. ovina* L. and *F. ovina* var. *vivipara* L. (*F. vivipara* (L.) Smith) are each lectotypified so as to preserve the usual current application of the names. The lectotype of the first name is in **GB**, and those of the latter two in **LINN**.

INTRODUCTION

Festuca ovina L. and *F. rubra* L. are two widely distributed and ecologically important grasses that exemplify two large, very variable aggregates of taxa. In *Flora Europaea* (Markgraf-Dannenberg 1980) 92 and 23 species respectively are attributable to these two aggregates, so that the precise typification of *F. ovina* and *F. rubra* is a matter of considerable taxonomic significance. *F. ovina* var. *vivipara* can be conveniently dealt with at the same time.

FESTUCA OVINA L., *SP. PL.*, 73 (1753)

Linnaeus took his diagnostic phrase-name unchanged from his earlier (1745) *Flora Suecica* account and listed four polynomials in synonymy, adding "Habitat in Europae collibus apricis aridis vulgatissimum". He also appended an unnamed variety β, later to be named as var. *vivipara*.

Linnaeus' own herbarium in **LINN** contains surprisingly little Swedish material and it seems that his Swedish herbarium was probably kept apart from his main collection and was lost or destroyed. Accordingly, there is no material which can be unequivocally associated with the *Flora Suecica* accounts.

The first synonym is from Linnaeus' *Samling of et hundrade wäxter upfundne på Gotland, Öland och Småland* (1741) but it is not associated with any known extant material. The second is from van Royen (1740) but no associated material in Adriaan van Royen's herbarium in **L** has been found (J. F. Veldkamp pers. comm. 1986). A polynomial from Linnaeus' *Flora Lapponica* (1737) account is cited third and associated with this are two specimens, one in Linnaeus' Lapland herbarium in the library of the Institut de France, Paris (see Fries 1861; Stearn 1957, p. 115) and another (92.1 in the Savage (1945) catalogue) in **LINN** bearing the entry number "55" and "e Lapponia" in Linnaeus' handwriting. These two specimens are possibly duplicates, and belong to the *F. ovina* aggregate. The fourth synonym is from Bauhin's *Pinax Theatri Botanici* (1623) also cited through Scheuchzer's *Agrostographia* (1719). The Burser herbarium in **UPS** does not in this instance contain any material which Linnaeus might have used in association with the Bauhin polynomial.

Specimen 92.2 in **LINN** also belongs to *F. ovina* agg. but it was sent to Linnaeus by Arduino in 1761 and hence has no relevance for the purposes of typification. There are four specimens in the Linnaean herbarium in **S** which have in the past been referred to *F. ovina*, but examination shows that two are entirely unannotated. However, one of the others (fiche 37.19) bears "1. ovina" and on the reverse "e Lapponia" in Linnaeus' handwriting. We have seen only a microfiche of this specimen, and from this cannot draw any conclusions as to the precise identity of the plant, even to the extent of determining it as *F. ovina* agg. rather than *F. rubra* agg. The last specimen (fiche 38.5) relates to *F. ovina* var. *vivipara* and is discussed under that name.

Specimen 92.1 in **LINN** does not bear the name or number of the *Species Plantarum* account, but the presence of the *Flora Lapponica* number and the correspondence of the specimen with that in Paris indicates that Linnaeus almost certainly collected it in Lapland in 1732 and it was hence available to him in 1753. It agrees fully with the *Flora Lapponica* diagnosis "Poa spiculis ovato-angustis aristato-acuminatis". This specimen was also examined by the late C. E. Hubbard (Kew) and by the late P. Auquier (Liège) and considered by both of them to be a suitable choice of lectotype and to be in accordance with the currently accepted concept of *F. ovina*, as well as with the protologue. Accordingly we designate specimen 92.1 in **LINN** as the lectotype of *F. ovina* L. (Plate 2A).

In the 1970s the concept emerged of 'typical' *F. ovina* sensu strictissimo as a diploid taxon characteristic of many regions of northern and central Europe, including northern Britain, but one of uncertain occurrence in southern Britain and not occurring in France or Belgium. This concept was developed mainly by Auquier, firstly in his doctoral thesis (Auquier 1974), where he stated (p. 196) "il parait vraisemblable que le matériel original de son (Linnaeus') *F. ovina* corresponde aux populations diploides communes en Europe septentrionale et centrale; Linné met d'ailleurs son espèce en synonymie avec des phrases descriptives tirées de flores de Scandinavie et de Suisse". Later the same concept was used by Auquier in other works, notably in the standard Belgian Flora (Auquier 1978), where (p. 757) he stated: "*Festuca ovina* L. s. str., espèce d'Europe sept., centr. et or., n'existe pas à l'état spontané dans le territoire [Belgium, Luxembourg, and immediately adjacent parts of France, Germany and Holland] de la Flore". Another leading festucologist, M. Kerguélen (Guyancourt), has followed the same interpretation (e.g. Kerguélen 1983, p. 16), and Markgraf-Dannenberg (1980, p. 145) also considered *F. ovina* to be a diploid taxon (the basis of her citing Belgium in the distribution is not known). The view that typical *F. ovina* is diploid and rare in western Europe has become generally accepted by the leading Continental festucologists, and we also are of this opinion. At Auquier's request, Hubbard had sent detailed measurements of specimen 92.1 to the former (letter of 2 May 1974), after which Auquier expressed the view (letter to Hubbard of 8 May 1974) that "Les mesures relevées sur l'enchantillon 92.1 concordent bien avec celles que j'ai notées sur des recoltes de Scandinavie et d'Europe centrale. Ces plantes diploides diffèrent par leur mensuration des populations tétraploides d'Europe occidentale". The critical measurements of the proposed lectotype are: spikelet length extrapolated to fourth floret 4.8–5.7 mm; second lemma length 3.0–3.5 mm; second lemma awn length 1–1.3 mm. Auquier (1977, p. 100) stated in print that "le nom de *F. ovina* doit être réservé aux populations diploides largement répandues en Europe boréale, centrale et orientale," and after he finally examined specimen 92.1 in **LINN** on 1 November 1979 he confirmed (orally to C.A.S.) that he considered this sheet to represent the diploid taxon. Hubbard's views are expressed in a note at the Linnean Society dated 8–9 April 1974, and in greater detail in the letter of 2 May 1974 mentioned above. Specimen 92.1 was also examined by M.J.W. in 1983, and the same conclusions drawn. A paper typifying *F. ovina* by specimen 92.1 was planned by Auquier and Hubbard (see Auquier 1977, p. 100), and at the time of their separate deaths in 1980 a draft manuscript had been prepared by Auquier (oral communication to C.A.S. 1980).

In most of Britain, Belgium and northern France, as well as in some regions further east, *F. ovina* sensu strictissimo is replaced by various tetraploid taxa. Their degree and level of distinction from each other and from *F. ovina* are being examined in several laboratories; some preliminary conclusions have been presented by Wilkinson & Stace (1985), but this is not the subject of the present paper.

FESTUCA OVINA VAR. *VIVIPARA*. L., *FL. SUEC.*, 2ND ED., 31 (1755)

Linnaeus recognized this proliferating grass as an unnamed variety in 1753 with the diagnosis "*Festuca spiculis viviparis*", but two years later gave it a formal varietal epithet. Four synonyms were cited, together with "Habitat in alpibus Lapponicis, ubi nullum gramen magis frequens".

There are no relevant specimens in the Linnaean herbaria in **H**, **MW**, **SBT** or **UPS**. Specimen 92.5 in **LINN** (noted by Frederiksen 1981, p. 287) is labelled by Linnaeus "1β" (the number of the taxon in *Species Plantarum*) and "Lappo" (=Lapponia, the area of collection).

The first synonym is taken from Linnaeus' *Flora Lapponica* account, no. 56, and there is a specimen bearing this name and number in his *Flora Lapponica* herbarium in the library of the Institut de France, Paris. There is also a further specimen bearing this number in Linnaeus' handwriting in **S** (fiche no. 38.5), which is almost certainly a duplicate. Of the remaining three synonyms, two are drawn from works by Scheuchzer and the third is from Ray. All three are accompanied by illustrations, but none can be associated with specimens that Linnaeus would have seen.

Specimen 92.5 in **LINN** was clearly used by Linnaeus when writing his *Species Plantarum* account and we formally select it as the lectotype. Hubbard (ms. note in Linnean Society dated 8–9 April 1974) reached the same conclusion.

Although Linnaeus' polynomial covers all proliferous *Festuca* taxa, which belong to many species (most but not all of them within the *F. ovina* aggregate), the lectotype conforms precisely with the modern concept of *F. ovina* var. *vivipara*, now usually known as *F. vivipara* (L.) Smith, *Fl. Brit.*, **1**: 114 (1800). *F. vivipara* in northern Scandinavia exists as both triploids and tetraploids and the lectotype could be either.

FESTUCA RUBRA L., *SP. PL.*, 74 (1753)

As with *F. ovina*, Linnaeus used the polynomial name that he had earlier used in *Flora Suecica* (1745, p. 93) as his diagnosis, and he cited one pre-Linnaean synonym from Scheuchzer. He also noted "Habitat in Europae sterilibus siccis". At the end of the entry Linnaeus added a sentence with further information for distinguishing *F. rubra* from *F. ovina*, suggesting that he knew *F. rubra* well: "Magnitudine, colore maturitatis rubro, culmo tereti sed altero latere planiusculo, distinguitur a F. ovina".

There are two specimens (92.9, 92.10) in **LINN** which are linked with this name. Specimen 92.9 is a member of the *F. rubra* aggregate and is labelled by Linnaeus "3 rubra" and, on the reverse, "Lapponia 52". The former represents the name and number of the species in *Species Plantarum*, and the latter would appear to be the origin of the specimen and its number in Linnaeus' *Flora Lapponica* account. However, entry number 52, *Poa spiculis ovato-oblongis, foliis subulatis*, is nowhere cited in the synonymy of *F. rubra*, but is instead to be found along with the reference "Fl. lapp. 52" as a synonym of *Poa angustifolia* L. There is a specimen, numbered "52" by Linnaeus and with the name "Poa spiculus ovato oblongis", in Linnaeus' Lapland herbarium in the library of the Institut de France, Paris. From a photograph it is clear that this specimen is a *Festuca*, not a *Poa*, and probably belongs to *F. rubra* agg.; it is possibly a duplicate of specimen 92.9 in **LINN**. However, since its name and number are referred in *Species Plantarum* to *Poa angustifolia*, not to *F. rubra*, it cannot be regarded as a syntype of the latter, nor used to typify it.

Specimen 92.9 does not represent the taxon now generally known as *F. rubra* (sensu strictissimo), but is an example of *F. richardsonii* Hooker (*F. rubra* ssp. *arctica* (Hackel) Govoruchin). This conclusion was reached without reservation by P. Auquier when he examined the specimen on 1 November 1979, and by S. M. Cunningham and C.A.S. when they examined it in 1982 (see also Kerguélen 1983, p. 9).

Specimen 92.10 also bears the number "3" in Linnaeus' handwriting, but Linnaeus additionally wrote "2" on the sheet. This suggests some change of mind as to whether *F. duriuscula* L. (number 2 in *Species Plantarum*) or *F. rubra* was the identity of this specimen, which is therefore not relevant for the typification of *F. rubra*.

There are three specimens in the Linnaean herbarium in **S** but none can be regarded as a syntype. One is unannotated by Linnaeus, a second was received by Linnaeus from Arduino in about 1761, and the third, although annotated by Linnaeus, lacks the figure "3" and was almost certainly acquired by him after 1753. The last sheet bears a specimen each of *F. rubra* ssp. *rubra* and *F. rubra* ssp. *commutata* Gaudin (*F. nigrescens* Lam.). No further relevant specimens are known amongst the Linnaean herbaria in **H**, **MW**, **SBI** or **UPS**.

However, a further specimen has recently come to light in the Botanical Museum, Göteborg (**GB**), which was not widely known to possess any Linnaean materials. During an informal discussion with C.E.J., Dr Lennart Andersson, now Botanical Curator at **GB**, said that he thought Linnaean material existed there. Dr Andersson's predecessor, Dr Bo Peterson, kindly confirmed that just one Linnaean specimen is in the herbarium, and that this is a sheet of *Festuca rubra*, collected near Uppsala and evidently in Linnaeus' possession by 1753. The sheet bears on the recto "3 rubra" and on the verso "in paludosis prati regii Upsalia", all in Linnaeus' handwriting. The presence of the "3" indicates that it is almost certain that the specimen was in Linnaeus' possession before 1753. Whilst it is true that the ecological information on the specimen does not agree with that given in the protologue in 1753 (i.e. "in Europae sterilibis siccis"), it is notable that the *Flora Suecica* (1745) account rather unusually omits any habitat details. It may well be that the **GB** specimen was collected prior to 1745 (and Linnaeus did state in *Flora Suecica* "habitat ubique in Suecia, praesertim in Uplandia"). Ecological descriptions for a species such as this were probably rather unimportant to Linnaeus as he frequently omitted mention of them. In any case, it is clear that Linnaeus possessed the specimen before 1753 and regarded it as belonging to his *F. rubra*, and so we accept it as a syntype.

Examination of the specimen by C.A.S. and M.J.W. shows that the collection consists of only the top parts of three flowering stems, but measurements of the spikelet parts (e.g. lemmas 5–6 mm, spikelets to fourth floret 7–8 mm) reveal that it is an example of the plant now commonly known as *F. rubra* ssp. *rubra*. Hence we select it here as the lectotype (Plate 2B).

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We are greatly indebted to the late Dr P. Auquier (Liège) for many fruitful discussions with C.A.S. on the taxonomy of the *F. ovina* aggregate, and similarly to Dr M. Kerguélen (Guyancourt) for much valuable help concerning the taxonomy and nomenclature of both *F. ovina* agg. and *F. rubra* agg. We are extremely grateful to Dr L. Anderson and Dr B. Peterson (Göteborg) for drawing our attention to the existence of the Linnaean specimen in their care, and for making it available for study. Our thanks are also due to the curators of the herbaria in **L**, **LINN** and **S** for allowing access to material, and to the library of the Institut de France, Paris, for permitting C.E.J. to study Linnaeus' Lapland herbarium. Dr J. F. Veldkamp kindly checked the existence and identity of van Royen material in **L** for us.

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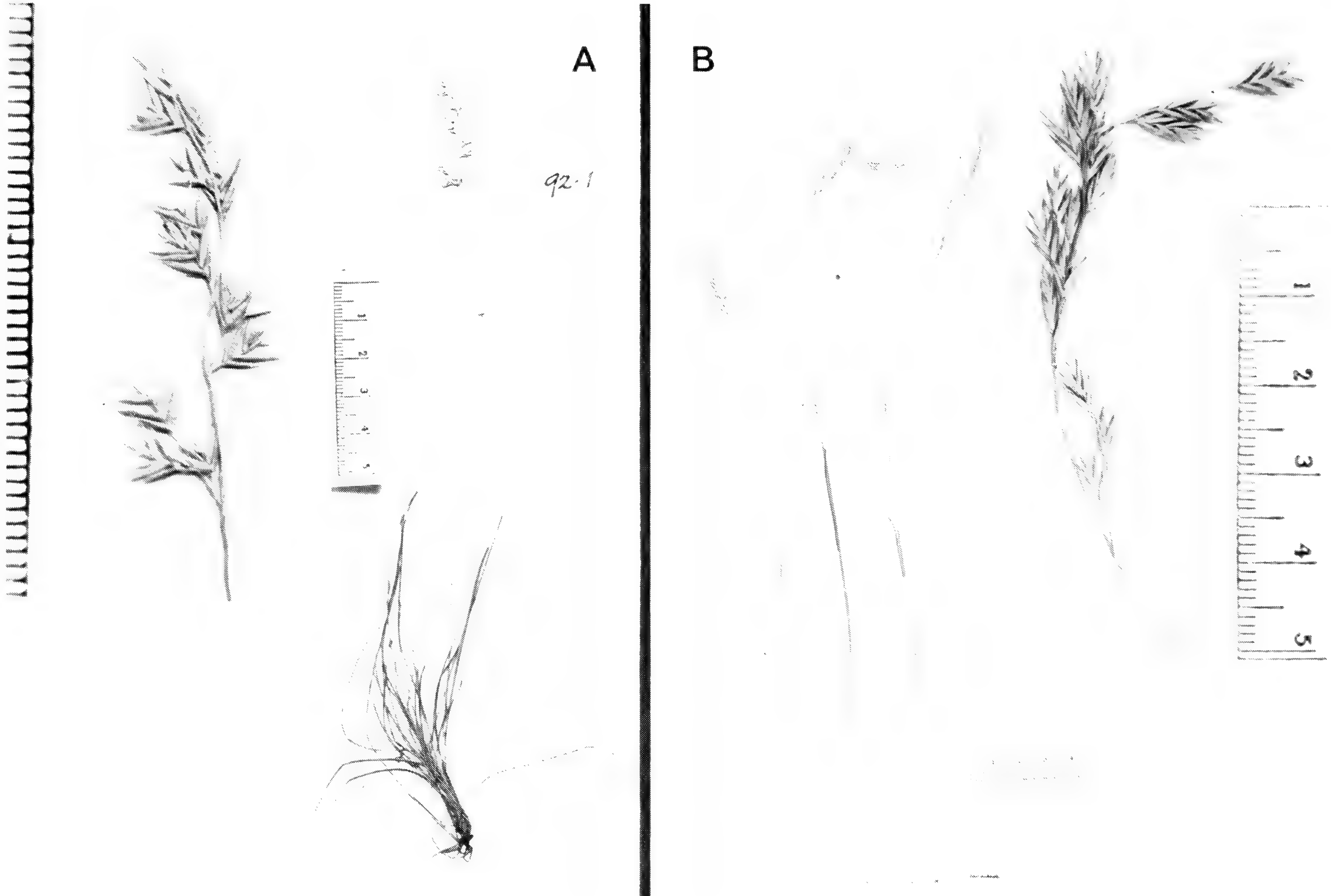

PLATE 2. Lectotype specimens: (A) *F. ovina* L. (**LINN** no. 92.1); (B) *F. rubra* L. (**GB**).

PLATE 3. *Festuca guestfalica* Boenn. ex Reichb. (A) lectotype in **H**; (B) possible isolectotype in **E**.

Typification and status of the mysterious *Festuca guestfalica* Boenn. ex Reichb.

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ABSTRACT

The discovery of the type specimen of *Festuca guestfalica* Boenn. ex Reichb. is described and its diagnostic features are presented. It is closely related to *F. ovina* L. and probably a tetraploid. It is concluded that there is insufficient evidence to identify any plants from the British Isles as this central European taxon.

THE *FESTUCA OVINA* AGGREGATE

In its broadest sense *F. ovina* L. consists of a large number of taxa widely distributed in Eurasia and North America. In *Flora Europaea* (Markgraf-Dannenberg 1980) 92 species (numbers 79–170) belong to this aggregate. Hackel (1882), in his monograph of European fescues, had earlier used almost exactly the same scope for his '*F. ovina* Linn. sens. ampliss.'; in fact only one of the 92 species recognized in the aggregate by Markgraf-Dannenberg (*F. hystrix* Boiss.) was excluded from it by Hackel.

In British Floras a range of circumscription has been adopted (Table 1). Howarth (1925) described the aggregate as '*F. ovina* L. sensu ampliss.' and Tutin (1952) as '*F. ovina* agg.' However, both these authors divided the group into separate species (five and four respectively). Howarth (1948) reduced the number of species he recognized from five to four, *F. supina* Schur having previously been recorded in error. Hubbard (1954) recognized five species. The later editions of Tutin and Hubbard do not differ from the first, apart from the use of the name *F. longifolia* Thuill. instead of *F. trachyphylla* (Hack.) Krajina by Tutin (1962).

Markgraf-Dannenberg (1980) recorded seven of her 92 species for Britain, and these were all briefly treated by Tutin (1981). In addition *F. armoricana* Kerguélen and *F. huonii* Auquier are known from the Channel Isles, but Markgraf-Dannenberg's record of *F. indigesta* Boiss. from Ireland is probably an error of identification. Since 1980 an eighth species, *F. ophioliticola* Kerguélen, has been recorded from Britain (Wilkinson & Stace 1985); all eight are listed in Table 1.

TABLE 1. TAXONOMIC TREATMENTS OF *F. OVINA* AGG. IN FIVE DIFFERENT WORKS

Howarth 1925	Howarth 1948	Tutin 1952	Hubbard 1954	Markgraf-Dannenberg 1980
F. capillata	F. tenuifolia	F. ovina ssp. tenuifolia	F. tenuifolia	F. tenuifolia
F. ovina	F. ovina	F. vivipara	F. vivipara	F. vivipara
		F. ovina ssp. ovina	F. ovina	F. ovina
				F. guestfalica
				F. ophioliticola
F. glauca	F. glauca	F. glauca	F. glauca	F. longifolia
F. longifolia	F. longifolia	F. trachyphylla	F. longifolia	F. trachyphylla
				F. lemanii

Our concept of *F. ovina* in Britain is covered by the descriptions of *F. ovina*, *F. guestfalica* and *F. ophioliticola* given in *Flora Europaea*, but it excludes the other five species. It is possible to subdivide taxonomically this concept of *F. ovina* (which may be called *F. ovina* sensu stricto), as Markgraf-Dannenberg has done, but we prefer to recognize such segregates at infraspecific levels rather than as species (Wilkinson & Stace 1985).

Festuca ovina has been typified (Jarvis, Stace & Wilkinson 1987) by a specimen in **LINN** which represents a northern diploid plant (*Festuca ovina* sensu strictissimo) which is common in Scandinavia and northern Britain but rare in southern England and apparently absent from Belgium and France. In these more southern areas it is replaced by various tetraploid taxa. Apparently the earliest name at specific level that could be used for any of these tetraploids is *F. guestfalica* Boenn. ex Reichb., and it is the application of this name that is the subject of the present paper.

TYPIFICATION OF *FESTUCA GUESTFALICA*

FESTUCA GUESTFALICA Boenn. ex Reichb., *Flora Germanica Excursoria*, p. 140 (3) (1831).
F. ovina ssp. *eu-ovina* var. *vulgaris* subvar. *guestphalica* (Boenn. ex Reichb.) Hackel, *Monogr. Fest. Europ.*, 87 (1882).

The name *F. guestfalica* has never been typified and was ignored by twentieth-century botanists until Markgraf-Dannenberg (1980) adopted the name in *Flora Europaea* for a plant that she claimed was distributed from Britain and France to Poland and Czechoslovakia. Reichenbach's description is too vague to give a good impression of the identity of the taxon, except that it belongs to the *F. ovina* aggregate. If it is part of *Festuca ovina* sensu stricto it is, from its distribution, probably a tetraploid. Markgraf-Dannenberg's (1980) concept was apparently intuitive, based upon her wide and long experience of the genus in central Europe. Although she gave "Br" in the distribution, we have seen no British material so labelled by her. The few records of *F. guestfalica* for Britain that have appeared in the literature recently are all errors, based on a misinterpretation of Markgraf-Dannenberg's concept of the species (e.g. Ellis 1983, p. 172). Kerguélen (1982, 1983) has considered this problem, and gave a brief description of a *Festuca* occurring in the Paris region that he thought came under Markgraf-Dannenberg's concept of *F. guestfalica*. However, he considered that this latter concept embraced several taxa, and he surmised that the typical species of Reichenbach, the Parisian plant, another related taxon from Le Mans, *F. ophioliticola* ssp. *calaminaria* Auquier, and at least three populations studied by Huon (1970) in western France probably came under this name. However, he had no information on the nature of the type material, identification of which he justifiably considered "indispensable".

Reichenbach's "*F. guestfalica* a Bnngh." (implying the name was supplied by Boenninghausen) was based on "*F. valesiaca* var. β Weihe D. Gräs. XI. no. 264.", said to come from "An Kalkfelsen im Sauerlande in Westfahlen" (Westphalia, W. Germany, hence the epithet *guestfalica*). W. Lippert (München) kindly informed us (in litt. 1983) that "D. Gräs. XI" refers to Weihe's exsiccatum set *Deutsche Gräser für Botaniker und Oeconomen*, XIte Sammlung, a set of which he and other central European grass taxonomists had been seeking unsuccessfully for some time.

In January 1984 we distributed with the University of Leicester Botanic Garden annual Seedlist an open request for information about Weihe's exsiccatum. This resulted in the location of at least two syntypes of *F. guestfalica*.

At Helsinki there is a set of fifteen bound volumes of Weihe's *Deutsche Gräser*, volume XI of which contains no. 264, which is indeed labelled "264. *Festuca valesiaca* var. β Am Felsen im Sauerlande" (Plate 3A), with no other data. Volume XI was kindly lent to us by I. Kukkonen. It contains 25 sheets (nos 251–275), as presumably do all the other volumes, but is undated (Fig. 1). Dr Kukkonen tells us that Volume I is dated 1st October 1817, and Volume XII October 1824, and that, since it contains a reference to Mertens & Koch's third edition of Röhling's *Deutschlands Flora* (1823), Volume XI must have appeared in 1823 or 1824. Sheet no. 264 is clearly the plant upon which Reichenbach's *F. guestfalica* was based.

From Leningrad also we received anonymously on loan a single sheet of no. 264 from the same volume. This has the same small printed label as that at Helsinki, under which someone has written 'Weihe'. This sheet is obviously another syntype. Presumably the set of exsiccata at Leningrad has

Deutsche Gräser.

Für

Botaniker und Oeconomen

getrocknet und herausgegeben

von

Dr. August Weihe.

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Vorerinnerungen.

1) Die Nummern im vorigen 10ten Hefte sind verdruckt, sie müssen gehen: von 226 bis 250; wo ich dieses nicht selbst geändert habe, wollen die Besitzer es gütigst verbessern.
2) Durch die neue, vortreffliche deutsche Flora, von Mertens & Koch, sind in meinen Gräsern manche Berichtigungen nöthig geworden, die ich vielleicht im nächsten Hefte schon anbringen werde. Auf dieses Buch habe ich nunmehro auch meine Citate bezogen.
3) Da ich den Scirpus lacustris im 5ten Hefte Nr. 110. vermischt mit Scirpus Tabernaemontani ausgegeben habe, so folgen beide hier berichtiget nebeneinander.

Weihe.

Inhalt

der eilften Sammlung.

FIGURE 1. Reproductions of title-page and contents-page of Weihe's rare *Deutsche Gräser*, Volume XI, at Helsinki.

been cut up and disposed into the herbarium in systematic sequence. No other examples of this rare set of exsiccata have come to light.

We also received on loan from Edinburgh a sheet ex "Herb. Dörfler. Purchased 1912." that bears no other printed labels but two handwritten ones (Plate 3B). The upper was written by Weihe (handwriting identified for us by B. Gries of Münster, H. E. Weber of Osnabrück and G. Wagenitz of Göttingen) and reads: "*Festuca valesiaca β hirsuta* . . . Weihe". The lower label starts "543 b *Festuca guestfalica* . . .", followed by a description and ends "(Weihe D Gräser 11 Heft) . . . guestfalia montibus calcareis." The handwriting has been identified for us by F. Kottwitz of Nortrup as that of Boenninghausen. The absence of the number 264 on this sheet indicates that this specimen cannot be considered a syntype, but in fact it might well be one. The description written by Boenninghausen agrees with that in Reichenbach's *Flora*, and the number 543 b might be an error for 243 b, which is the number of *F. guestfalica* in the *Flora*. Moreover the reference to Weihe's exsiccata, Volume 11, by Boenninghausen, and use of the name *F. valesiaca β* by Weihe, tie the specimen in with no. 264 in the exsiccata volumes. There remains the possibility that Weihe's and Boenninghausen's labels were referring to the fact that the Edinburgh specimen was taxonomically the same as *F. guestfalica*, rather than it being a type, even though the specimens appear so similar that they might have come from the same gathering. The most important aspect of the Edinburgh specimen, however, is that it bears a label by Boenninghausen with the name *F. guestfalica*, which (uniquely) confirms Reichenbach's attribution of the origin of the name.

Accordingly, we designate the Helsinki exsiccatum as lectotype, the Leningrad specimen as isolectotype, and the Edinburgh specimen as a possible isolectotype.

DESCRIPTION AND DISTRIBUTION OF *FESTUCA GUESTFALICA*

Our concept of *F. guestfalica* is based upon the three specimens mentioned above and upon a number of other herbarium specimens in **HAL**, **W** and **Z**, from Germany and Switzerland, that resemble the former closely and are obviously conspecific with it. Diagnostic measurements of the type material are as follows: plant height 45–60 cm; leaf-blades Y-shaped to V-shaped in section, with 2 grooves, 1 ridge, 6–7 veins and continuous or slightly broken, rather thin sclerenchyma; panicles (6)8–12 cm; spikelets (to tip of 4th floret excl. awn) (6.1)6.5–7 mm; lower glume (2.6)2.8–3.6(4.4) mm; upper glume (3.2)3.5–4.4(4.6) mm; lemmas 4–4.5 mm; lemma awns (0.3)0.5–1(1.2) mm. The most notable feature of the types is the very lax panicle, setting the plants well apart from most others in the *Festuca ovina* aggregate.

A more extended description based upon all the above material follows (Fig. 2) (measurements are means of specimens):

Plants laxly tufted, with only intravaginal shoots, without rhizomes, retaining or shedding old leaves. Culms (30)36–58(68) cm, with 2–3 nodes (excl. inflorescence), the uppermost not pruinose, usually visible beyond subtending sheath and reaching 11–26% up culm; stem below inflorescence 0.4–0.7 (0.8) mm wide, scabrid or occasionally smooth, strongly grooved when dry. Leaves green, subpruinose or not; sheaths 2.9–7 cm, fused for 0–39% of length, smooth or occasionally scabridulous in upper half, hairy or glabrous; auricles short, minutely ciliated or occasionally glabrous; ligules <0.5 mm, minutely ciliated; blades 6.8–19.7 cm, very lank, not acutely pointed, 0–40(50)% on each plant curved at tip, scabrid at least in upper third, glabrous or hairy at base.

Inflorescences nodding or slightly so, 6–12.4 cm, very lax, with (8)10–14 nodes and 20–36(41) spikelets; branches not pruinose or occasionally subpruinose, not narrowing below spikelets, scabrid or scabridulous, the lowest two 1.7–3.6 cm apart. Spikelets (6.6)6.7–7(7.1) mm, with 3–8 florets (the most apical one reduced and sterile), not pruinose or occasionally subpruinose; pedicel 1.4–2.3(2.7) mm, scabrid or scabridulous; lower glume narrowly triangular to narrowly lanceolate, 2.5–3.3×0.6–0.8 mm, scabrid at tip, ciliate at margin, with 1 vein; upper glume lanceolate to narrowly so, 3.45–4.3×0.9–1.15 mm, scabrid or hairy at tip, ciliate at margin, with 3 veins; lemmas 3.8–4.4 (excl. awn)×1.6–1.9 mm, lanceolate, hairy or scabrid in distal half, with 5 veins, with awn 0.6–1.1(1.9) mm; paleas linear-lanceolate, 4–4.8×0.65–0.85 mm; anthers yellow or purple, (2.2)2.4–3.1 mm.

Leaf-blade in section: laterally compressed to oval, with margins not or slightly infolded, (0.46)0.57–0.69(0.75) mm diameter/thickness ratio 1.9–2.5(2.7), with (5)7 veins, 2(4) grooves

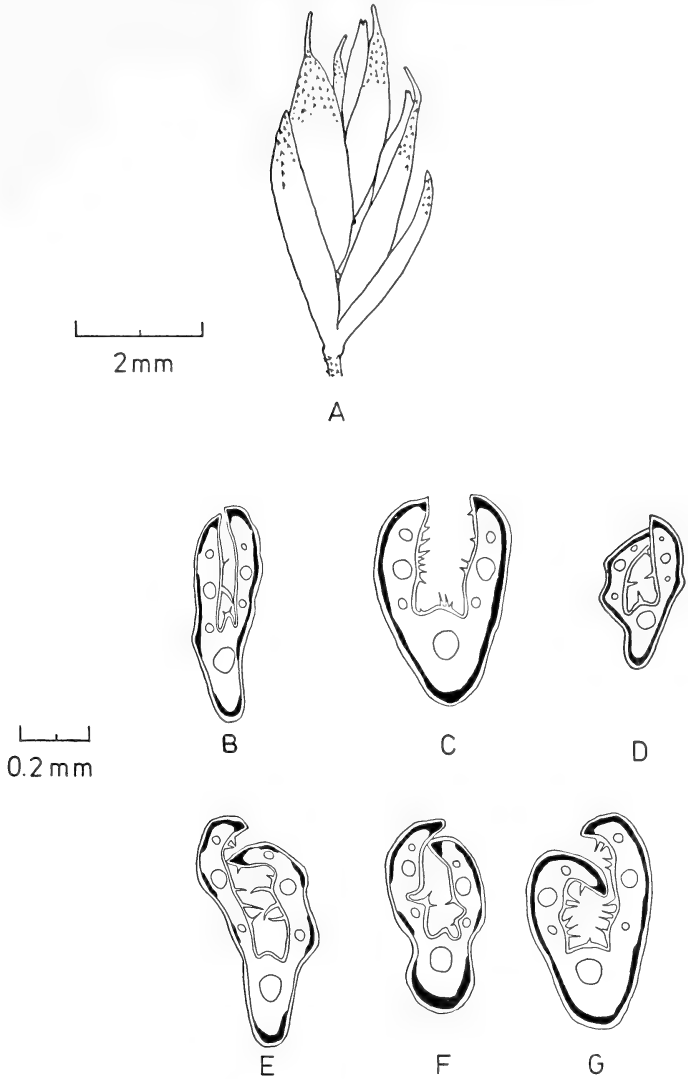

FIGURE 2. Spikelet (A) and transverse sections of leaf-blades of sterile shoots (B–G) of *F. guestfalica*. (A) lectotype; (B) lectotype; (C) Edinburgh possible isolectotype; (D) Leningrad isolectotype; (E, F, G) unlocalized German and Swiss specimens in Zürich.

and 1(3) ridges on adaxial surface; sclerenchyma forming thin broken ring or sometimes unbroken ring 1–2 cells thick; adaxial midrib 0.07–0.1(0.17) mm wide and 0.02–0.06 mm deep; adaxial epidermal cells ±uniform in size, lacking bulliform cells, with prickles (12.5)20–40(46.5) μm long.

Leaf-blade adaxial epidermis: stomata (33.5)35.5–39.75(44.5) μm long, (20)40–80(85)% solitary, 8–56(76)% with accompanying prickle-cell, 3–24% with accompanying silica-cell; prickles 63–93% solitary, 7–14(34)% forming rows of 2-few cells, 2–9(18)% with accompanying silica-cell. Leaf-blade abaxial epidermis: stomata absent; long-cells with highly sinuous walls, (105)140–185(250) μm long; silica-cells and cork-cells present; prickles usually present.

We have encountered two British specimens that agree well with the lectotype in all critical characters. One is a voucher (now in **K**) of a plant used by T. J. Jenkin in the hybridization experiments carried out at Aberystwyth in the 1930s, 1940s and 1950s. The plant is that described by him as *F. ovina* (Sheet 28, Experiment B143) (Jenkin 1955). He found it to be a tetraploid (2n=28), and he obtained hybrids between it and *F. rubra* L. It originally came from an acid heath in Pembrokeshire, Wales. The other is a plant collected fresh by T. C. G. Rich at Gaitbarrows, W. Lancashire, England and cultivated at Leicester. Like the type of *F. guestfalica*, it came from a limestone area. It is also a tetraploid (2n=28), with all the chromosomes metacentrics or submetacentrics and the ratio of largest to smallest chromosomes 1.7.

We cannot confirm or deny the more extensive distribution of the species given by Markgraf-Dannenberg (1980). We have seen only three specimens determined by her, and these do agree with our concept of the species, but it must be remembered that her circumscription of the species was drawn without having seen the type specimens. The plants from France thought of as possible *F. guestfalica* by Kerguélen (1982, 1983) are not good matches for the type material, and we have seen no material of *F. guestfalica* from France, Belgium or Holland.

TAXONOMIC STATUS OF *F. GUESTFALICA*

At first glance the type and similar specimens from Germany and Switzerland appear to represent a very distinct taxon. By far the most distinctive character is the widely spreading, lax panicle, quite unlike that usually found in *F. ovina* sensu stricto or indeed within the *F. ovina* aggregate. The most similar western European taxa appear to be *F. ovina* ssp. *ophioliticola* (Kerguélen) M. Wilkinson and *F. lemanii* Bastard, both of which normally possess much more contracted inflorescences, shorter, stiffer leaf-blades and shorter leaf-sheaths than *F. guestfalica*. Apart from this *F. lemanii* differs mainly in its shorter pedicels, shorter lemma-awns, shorter anthers, 2–4 (rather than usually 2) grooves on the leaf-blades, and longer stomata (Table 2). These differences seem consistent and within the *F. ovina* aggregate are of the order normally representative of different species.

F. ovina ssp. *ophioliticola* differs additionally from *F. guestfalica* mainly in its shorter anthers (more or less as in *F. lemanii*) and shorter upper glumes (Table 2). These differences are less convincing.

It is possible that *F. guestfalica* is a distinct species, but equally possible that it is an extreme variant of *F. ovina* ssp. *ophioliticola*. The two British plants closely resembling *F. guestfalica* throw some light on this point. Both Jenkins (1955) and T. C. G. Rich (pers. comm. 1985) collected the plants in the belief that they were representative of the segregate of *F. ovina* common in each of the areas concerned. Yet no herbarium material of wild-collected *F. ovina* that we have seen from those areas (or indeed from anywhere in Britain) closely resembles *F. guestfalica*. The two British specimens that do seem identifiable with that taxon represent cultivated material, and it is likely that they do not represent phenotypes normally encountered in the wild. Bidault (1968, p. 242) listed panicle length and innovation leaf-length as two of the more plastic characters in *Festuca*. The wide disjunction between the two British sites, and between those and the type locality of *F. guestfalica*, suggest that it is unlikely that the former are outposts of a central European taxon.

We conclude that more investigations in Westfalia are needed to investigate the status of *F.*

TABLE 2. DIAGNOSTIC CHARACTERS OF *FESTUCA LEMANII*, *F. GUESTFALICA* AND *F. OVINA* SSP. *OPHIOLITICOLA*

Character	*F. lemanii*	*F. guestfalica*	*F. ovina* ssp. *ophioliticola*
Pedicel length (mm)	0.6–2(2.4)	1.4–2.9	(1.3)1.4–2.8(3.6)
Spikelet length (mm)	(6.1)6.5–7.5(8.5)	(6.6)6.7–7(7.1)	(5.5)5.9–7(7.5)
Upper glume length (mm)	(3.4)3.5–4.6(4.8)	3.45–4.3	3–3.9(4.9)
Lemma awn length (mm)	(0.34)0.6–1.6(1.9)	0.6–1.1	(0.3)0.5–1(1.6)
Anther length (mm)	1.8–2.5	(2.2)2.4–3.1	(1.65)1.85–2.2(2.85)
No. leaf-blade grooves	2–4	2(–4)	2(–4)
Stomatal length (μm)	(31)38–45.8	(33.5)35.5–39.75(44.5)	31–39.5
Chromosome number	42	?28	28

guestfalica, but that, whatever the results of such studies, it is probable that the British plants are extreme ecophenes of *F. ovina* ssp. *ophioliticola*. If these two taxa are the same, it should be noted that *F. guestfalica* is the correct name at the species level, but ssp. *ophioliticola* is correct at the subspecies level.

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We are most grateful to the many herbarium curators who searched (mostly unsuccessfully) for specimens on our behalf, especially to Dr I. Kukkonen (Helsinki) for loaning us Volume XI of the Weihe set of exsiccata. We are also indebted to the following for much helpful advice on Weihe and Boenninghausen and on the taxonomy of *Festuca*: B. Gries, M. Kerguélen, F. Kottwitz, W. Lippert, F. Runge, G. Wagenitz and H. E. Weber; and to T. C. G. Rich for providing living material of *Festuca*.

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The distribution of *Erica erigena* R. Ross in Ireland

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ABSTRACT

Erica erigena R. Ross (*E. mediterranea* auct. non L., *E. hibernica* (Hook. & Arn.) Syme non Utinet), Irish Heath (Ericaceae), has a disjunct distribution in Europe. It occurs in the Iberian Peninsula, at Bordeaux in western France, and in counties Mayo and Galway in the west of Ireland, but is absent from the remainder of the European mainland. The distribution of *E. erigena* in Ireland is mapped and discussed in detail, and site maps are presented for the major stations of the heather in Mayo and Galway. Relevant earlier accounts are discussed. The Irish stations of this species are at present secure, but face a potential threat from further exploitation of blanket peat and reclamation of former peatland.

INTRODUCTION

Erica erigena R. Ross (*E. mediterranea* auct. non L., *E. hibernica* (Hook. & Arn.) Syme non Utinet), Irish Heath, has a markedly discontinuous distribution in western Europe. It occurs in the Iberian Peninsula in southern Spain (see Cebrian 1948; McClintock 1971), along the coast of Portugal from Serra de Monchique to Oporto (Malato-Beliz 1982), in north-western Spain (Fraga 1984) and in eastern Spain in the province of Valencia (Mansanet *et al*. 1980; Costa, Peris & Figuerola 1983). There is also a small population north of Bordeaux in western France (Besançon 1978), but the heather does not occur elsewhere on the continental mainland. It is not a native species in Britain, but was formerly naturalized in Cornwall (Williams 1911). In Ireland, *E. erigena* is confined to counties Galway and Mayo, where its distribution is again disjunct. The most southerly site is Errisbeg, near Roundstone in Connemara, Co. Galway; the most northerly population is on the Mullet Peninsula, Co. Mayo. The western extremity of its Irish range is on the shore of Lough Nakeeroge on Achill Island, and the most easterly site is on the eastern shore of Lough Conn, both in Co. Mayo.

The first published account of the heather in Ireland was presented by Mackay (1830) who reported the Errisbeg colony. However, herbarium specimens had been collected in western Ireland by Edward Lhwyd as early as 1700 (Nelson 1979). These are lodged in the Morrisonian Herbarium, University of Oxford (**OXF**). Since 1830 numerous papers have dealt with the distribution of *E. erigena* in Ireland, but examination of these reports shows that its Irish distribution is not clearly defined. Many of the accounts are couched in general terms, others are confused. In this paper we aim to present a comprehensive and updated description, with site maps that clarify the present distribution of the plant in the west of Ireland. The distribution of *E. erigena* in all its known sites in Galway and Mayo is discussed systematically, and pertinent earlier descriptions are noted. This paper is based on the authors' field studies between 1982 and 1984, and voucher specimens for all the populations noted have been deposited in the Irish National Herbarium, National Botanic Gardens, Glasnevin (**DBN**).

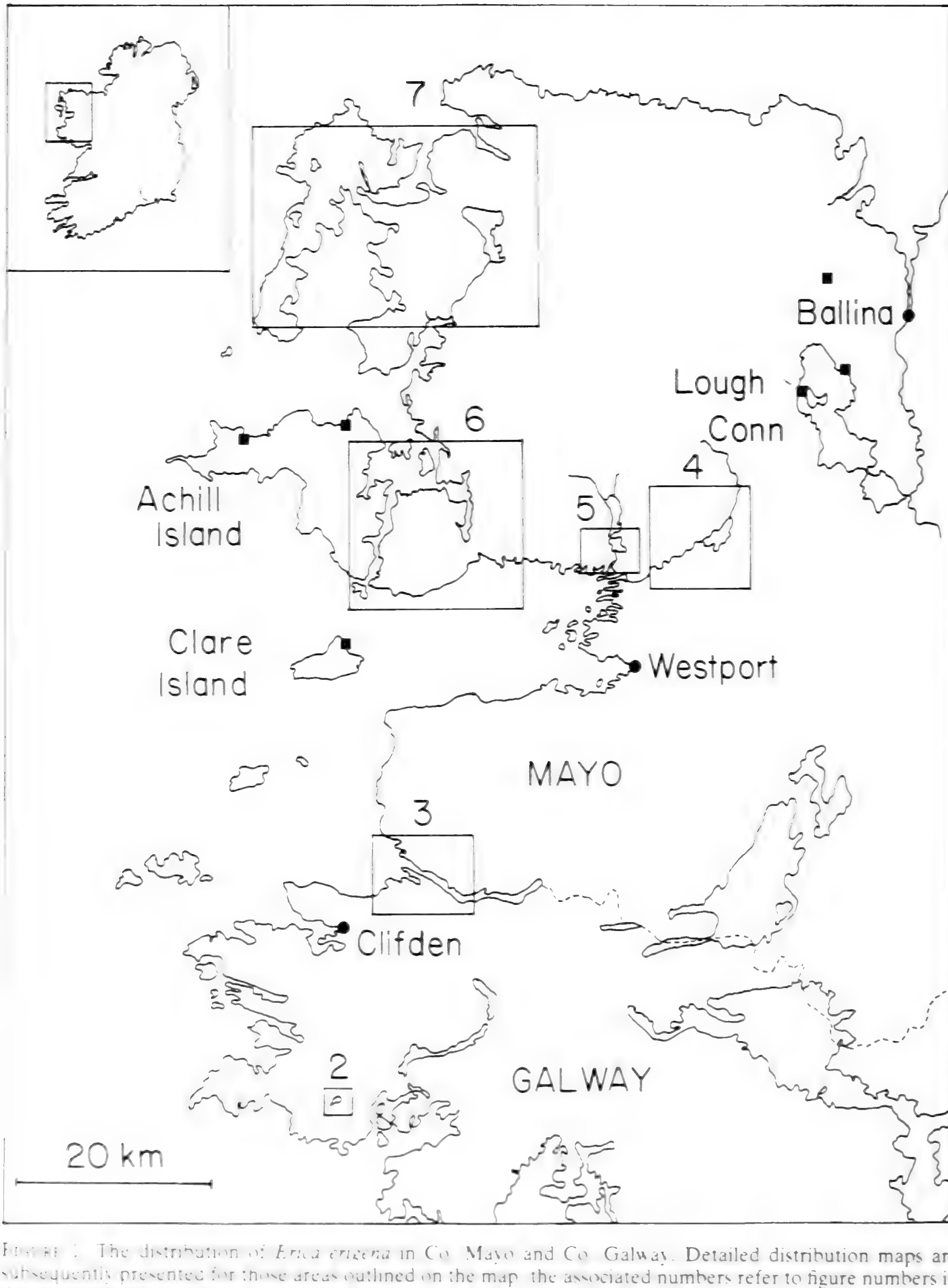

FIGURE 1. The distribution of *Erica erigena* in Co. Mayo and Co. Galway. Detailed distribution maps are subsequently presented for those areas outlined on the map: the associated numbers refer to figure numbers in the text. The colonies lying outside the major areas of distribution are shown by means of solid squares.

TABLE 1. THE GEOLOGY OF THE AREAS IN WHICH *ERICA ERIGENA* GROWS IN CO. MAYO AND CO. GALWAY, LISTING SITE, IRISH NATIONAL GRID REFERENCE, GEOLOGY AND LITERATURE SOURCE

Site	Grid Ref.	Geology	Reference
Errisbeg	L690.415	Base-rich metagabbros, especially black gabbros, epidiorites and dolorites	Bremner & Leake 1980
Gowlaun	L745.640	Silurian shale	Whittow 1974
Mweelrea	L780.655	Palaeozoic sediments, grits, brown sandstones, conglomerates & sedimentary rocks of volcanic origin	Whittow 1974
Clare Island	L705.870	Dalradian sandstones & slates, Carboniferous sandstones, shales and conglomerates, and various Silurian rocks	Cole *et al.* 1914
Lough Beltra	M070.980	Old Red Sandstone on the eastern shore: Carboniferous sandstones on the south and western shores	Whittow 1974
Lough Conn	G145.130 G195.147	Carboniferous limestones	Whittow 1974
Crossmolina	G170.240	Carboniferous limestone	Whittow 1974
Furnace	L975.980	Old Red & Carboniferous sandstones	Whittow 1974
Mallaranny	L825.980	Dalradian schists	Whittow 1974
Curraun	L770.970	Dalradian schists & quartzites: Old Red Sandstone on the southern coast	Whittow 1974
Achill	F697.085 F585.080	Dalradian schists	Whittow 1974
Bangor-Erris		Dalradian schists & Quartzites, Lewisian gneiss & Carboniferous sandstone. These are overlaid by podzolized glacial drift, from the Munsterian Cold Stage, covered by blanket peat	Whittow 1974; Linton 1964; Orme 1969; Synge 1968; Synge & Stephens 1960; Doyle 1982

DISTRIBUTION

The distribution of *Erica erigena* in Co. Mayo and Co. Galway is shown in Fig. 1. The major centres of distribution, for which individual maps are presented later in the text, are indicated in the diagram. The main localities are dealt with in detail in the text. The geology of each site is presented in Table 1, along with the Irish National Grid reference and appropriate literature references.

ERRISBEG, ROUNDSTONE, CO. GALWAY

Mackay (1830) noted finding *E. erigena* at Roundstone, and described its distribution as "a declivity by a stream, in boggy ground, at the foot of Urrisbeg mountain, near Roundstone, on its western side; occupying a space of above half a mile [0·75 km] in length, and covering between two and three acres [c. 1 ha] of ground". Nelson (1982) noted that Mackay confused the story of the rediscovery of the plant in later years. Mackay referred to visiting Connemara in 1829, while in the paper, read on 30th November 1830, he stated that he had found it during an excursion "in the latter end of the last month" (i.e. October 1830). Praeger (1934, 1939) gave a similar account of the Errisbeg site but also indicated that the species occurred "around Lake Nalawney as well as on the slope of Urrisbeg [sic] from 350 feet [106 m] down to Lough Bollard". Gay (1957) reported the heather "around L. Nalawney on the south and east side, a little on the stream leaving the lough,

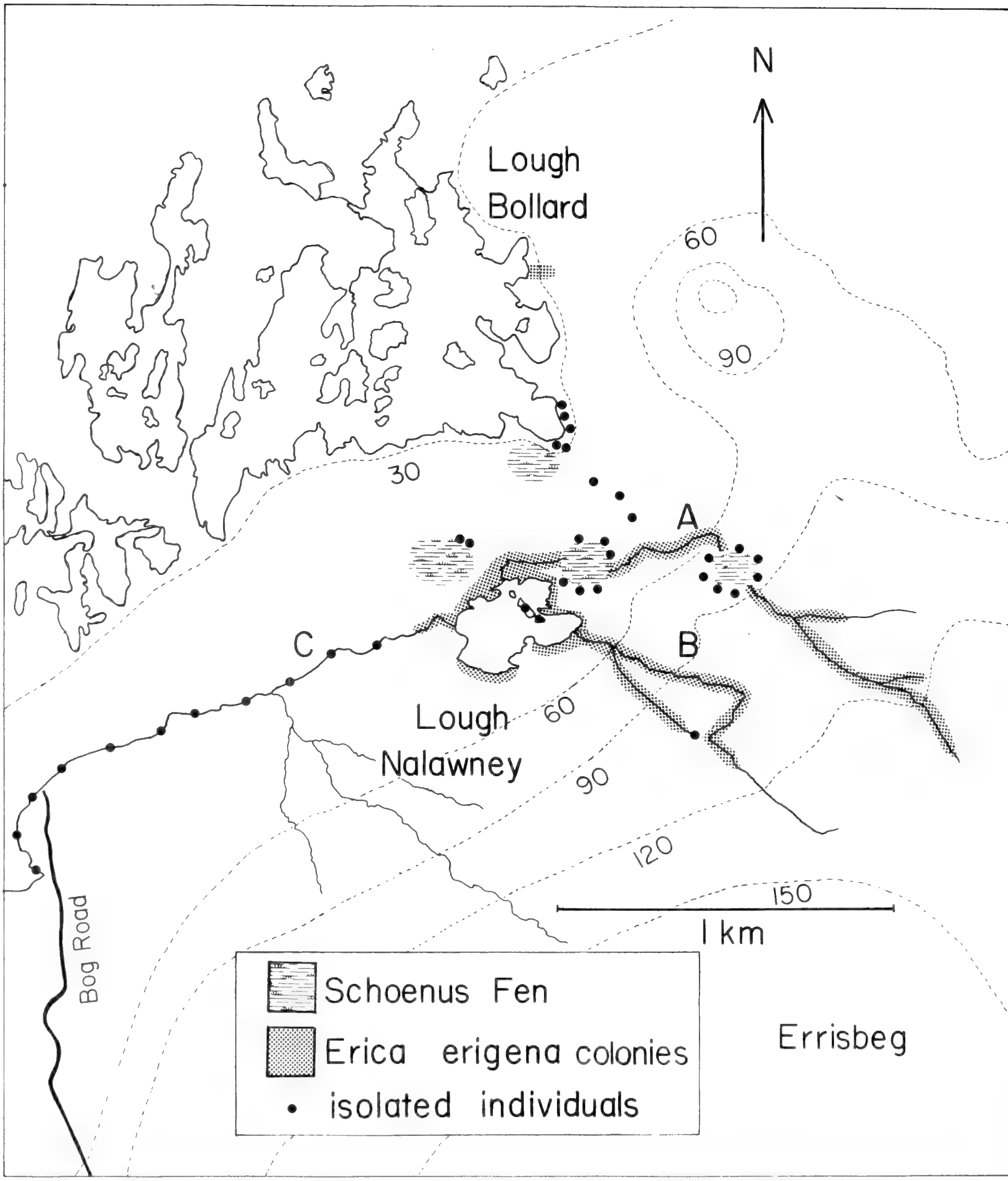

FIGURE 2. The distribution of *Erica erigena* at Errisbeg, Roundstone, Co. Galway. The main streams running down the north-west facing slope are marked A and B. The outlet stream from Lough Nalawney is marked C. The contour lines are marked in metres.

but more on the stream entering it from Errisbeg". He also found some plants "on Errisbeg well isolated from the main area". Webb & Scannell (1983) defined the distribution of *E. erigena* at Errisbeg as follows – "In fair quantity around L. Nalawney, spreading up the feeding streams for some distance, and rather sparsely down the effluent stream and over the saddle to L. Bollard, where there are a few plants on the S. shore; there is also an outlying colony on wet, level bog about 1 km S.W. of L. Nalawney".

The population of *E. erigena* at Errisbeg is more extensive than indicated in these earlier accounts. The heather grows in a narrow belt, at its widest 1·5 m broad, on much of the shore of Lough Nalawney (Fig. 2). There is a larger colony on the northern shore where the stream (A in Fig. 2) that rises near the summit of Errisbeg enters the lough. Along this particular stream the plant grows in abundance for a distance of 1·5 km up the slope of Errisbeg, to an elevation of 140 m. The heather has colonized the small tributaries of this stream but does not extend further than 200 m from the main channel. The stream passes through two large, quaking *Schoenus nigricans* L. fens, where isolated *E. erigena* bushes are confined to elevated *Schoenus* tussocks around the edges.

The heather is also plentiful along the second stream on Errisbeg (B in Fig. 2) but does not extend much above an elevation of 100 m.

Where the streams form deep, steep-sided channels the heather grows on the banks in dense stands often 1–2 m wide. Where the streams flow through level terrain and water spreads over a wide area, the plants form stands up to 30 m across. There is considerable variation in the habit of bushes growing by the streams, with a general decrease in size and vigour with increasing altitude.

The heather occurs along the outlet stream (C in Fig. 2) from L. Nalawney. It is abundant close to the lough, but rapidly decreases until only isolated bushes occur on the stream bank.

About 20 small bushes form four discrete colonies in the area between Lough Nalawney and Lough Bollard. A similar number of bushes grow along a 200 m stretch of the south-eastern shore of Lough Bollard, and in a small flush running into that part of the lake. Another site has been found (N. Kirby, D. Hogan & C. O'Connell pers. comm. 1984) on the eastern shore, to the north of the previous site. Here the heather grows in a small flush flowing into the lake, and on well-developed tussocks of *Schoenus nigricans* and *Molinia caerulea* (L.) Moench.

GOWLAUN, CO. GALWAY

The Gowlaun colony, described in detail by Scannell (1976), may be the remnant of a population mentioned in general terms by J. MacKinnon as "around Salruck Pass" (Colgan & Scully 1898). Praeger (1934) reported that *E. erigena* was "not infrequent" in the Kylemore area, but this species is not known at Kylemore today.

North-east of Gowlaun *E. erigena* grows on the headland east of Islandlyre, on the northern shore of the Culfin River estuary (A in Fig. 3). At this coastal site, *E. erigena* grows in two distinct habitats. A small colony of depauperate bushes is found on level reclaimed peaty ground, where a hummock/hollow system has developed as a result of treading by domestic animals. The second colony is located on a small, stony bluff, where the heather grows vigorously from cracks in the rocks. A few isolated bushes occur along the edge of the Culfin River (B in Fig. 3), near the road. These plants were first noted by Mrs. Willoughby (Magor 1981).

MWEELREA, CO. MAYO

E. erigena was first reported on Mweelrea, on the northern shore of Killary Harbour by Simon Foot & Joseph Hooker in 1835 (Mackay 1836a). Ninian Niven (1836) visited Mayo and Galway, including Mweelrea, in August 1836, and noted *E. erigena*, but it is not clear if he saw the plant at Mweelrea or at Errisbeg, which he also visited. Hart (1883) found the plant along a stream near Bunnaglass up to 30 m above sea level. Praeger (1911a) reported it from Killary, growing on a rocky bluff at the base of Mweelrea Mountain. Gay (1957) found a few bushes by a stream on the western part of the northern shore. He recorded large quantities further east, where it was dominant over extensive areas and grew to an elevation of 250 m on the slopes of Mweelrea, and also found it colonizing abandoned 'lazy beds' (potato drills) in some places. D. A. Webb stated that the heather grew in great quantity immediately north of the harbour mouth, on the flanks of Mweelrea, from 120 m down to sea level, and that this was the second largest station in Ireland (see McClintock 1969).

The distribution of *E. erigena* on the northern side of Killary Harbour is shown in detail in Fig. 3. The heather is first encountered on two small streams that run off the western flank of Mweelrea, south of the Bunanakee River. It is generally confined to the stream edges and to adjacent level flushes, but some isolated bushes grow beside a path linking the two streams. To the east of this area *E. erigena* becomes more abundant, growing along numerous streams and in flushes, from sea level to 150 m. The largest stand of the heather in this area spans a group of four streams about 3·5

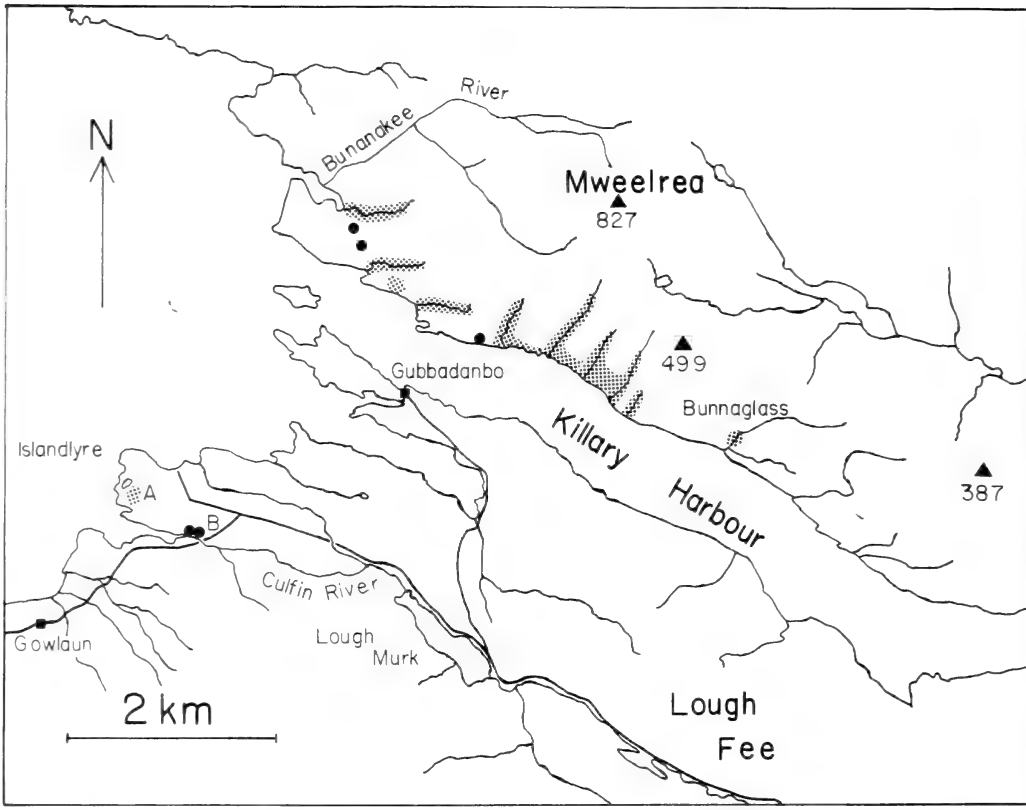

FIGURE 3. The distribution of *Erica erigena* at Gowlaun, Co. Galway, and at Killary Harbour and Mweelrea, Co. Mayo. The coastal site near Gowlaun is marked A. The station on the Culfin River is marked B. Mountain peaks are indicated by solid triangles, the associated numbers are heights in metres. Extensive colonies and isolated heather bushes are depicted by stippled areas and solid circles respectively.

km from the mouth of the harbour. *E. erigena* dominates the lower slopes of the mountain, growing on stream banks, in flushes and on small boulder clay banks above the high water mark. The plant has colonized abandoned 'lazy beds' in the vicinity, where it is confined to the troughs. The most easterly site is on the stream-bed at Bunnaglass, as originally reported by Hart (1883).

CLARE ISLAND, CO. MAYO

In an earlier botanical account of Clare Island, Praeger (1903) indicated that a "constant search" had failed to locate this or the other "western heaths" (i.e. *Daboecia cantabrica* (Huds.) C. Koch and *Erica mackaiana* Bab.). In the botanical section of the report of the Clare Island Survey, Praeger (1911b) remarked that one of the important additions to the island's flora was *E. erigena*. He reported *E. erigena* as "abundant on boulder-clay slopes (no trace of peat) facing north-east, from storm level to about 70 feet [c. 20 m], between Portlea and Ooghcorragaun . . . A couple of outlying plants on top of the low cliff at east end of Portlea". The heather was found in the same spot by McClintock (1969) "still in fair quantity and condition".

The Clare Island site was visited in August 1984. The heather is confined to a steep, north-east facing, deeply eroded boulder-clay bank in the area described by Praeger, about 200 m south of the abandoned harbour at Portlea. It was growing vigorously, reaching a height of 75 cm.

LOUGH BELTRA, CO. MAYO

The descriptions of the populations of *E. erigena* at Lough Beltra demonstrate most clearly the need for a general restatement of this species' distribution. Praeger (1934) noted that "this little-known lake is remarkable for the fine fringe of *Erica mediterranea* [*E. erigena*] which, as at Carrowmore Lake to the NW [north-west], covers the broad stony storm-beach of the eastern side, half of it submerged during average floods". Webb (1954) described the fringe of heather as "very narrow and precise". Gay (1957) mapped the colony on the eastern side of the lake and other colonies along the edges of a stream entering the lough from the south and by Derrynafreva and Derrynaloughan loughs. McClintock (1966, 1969) noted the Beltra colonies; in the latter paper he wrote that "there is still a good colony covering a quarter of a mile [0·4 km] or so towards the south end of the west side of this lake and also on the land side of the road in a young forestry plantation", and he also stated that "Webb has seen it at the extreme south end". McClintock's reference to a colony on the western shore was an obvious printer's error (McClintock pers. comm.).

The distribution of the heather around Lough Beltra was mapped in the spring of 1984. It grows in abundance on both the eastern and western shores. On the eastern shore, the fringe is 20 m wide and extends 1·5 km along the shore (B in Fig. 4). Throughout, the heather grows on a thin layer of peaty sand overlying a rocky substrate, and is either the dominant shrub, or co-dominant with *Myrica gale* L. There is a rocky storm-beach in front of the main heather zone, where isolated bushes grow on eroding soil hummocks. On the landward side of the main fringe, scrub dominated by *Alnus glutinosa* (L.) Gaertn. and *Ulex europaeus* L. contains a few isolated heather plants. There are some bushes scattered to the east of the road, both in the forest plantation as mentioned by McClintock (1969) (A in Fig. 4), and to the north of the main shore colony (C in Fig. 4).

On the western side of the lough, *E. erigena* forms a sparse fringe along much of the shoreline, at or just below the high water mark (D in Fig. 4). In some places there are large colonies that penetrate about 30 m inland on cutover bog. The heather does not occur in some areas where the shore is sandy. It also forms an encircling fringe on the two larger islands in the western part of the lough.

On the southern shore (E in Fig. 4) there is a well-developed colony. Much of the area is covered by a narrow band of heather 1–4 m wide, but in one place the heather dominates a headland about 30 m across. It is found only on one of the two streams that enter this area from the cutaway bog to the south (F in Fig. 4). Between the lough shore and the confluence of the two streams there are isolated bushes on the steep banks. Along the remainder of the channel the heather grows abundantly on the peaty edges and extends on to adjacent cutover bog at the southern end of the stream (F in Fig. 4).

E. erigena is also found on the shores of two loughs that lie to the west of the stream. The smaller Derrynaloughan Lough (G in Fig. 4) comprises two lakelets on a feeder stream to the Newport River, the main outflow from Lough Beltra. *E. erigena* grows on the shores of both lakelets, for a short distance along several drains flowing into them, and on the exit stream from the more westerly of the two. The larger Derrynafreva Lough (H in Fig. 4) lies directly on the Newport River, and has a discrete colony of *E. erigena*, forming a band 10–15 m wide along its eastern shore.

LOUGH CONN, CO. MAYO

Specimens of *E. erigena*, collected at Enniscoe House on the western side of Lough Conn, were sent by J. T. Mackay to W. McNab at the Royal Botanic Gardens, Edinburgh on 24th October 1837 (McClintock 1966). Praeger (1900) reported six heather bushes on the eastern shore of L. Conn "on a patch of bog on the shore opposite Annagh Island", and commented that this was the most easterly station in Ireland. He also described its habitat on the western shore, again on boggy ground, from the Errew peninsula northwards to Enniscoe House. Gay (1957) and McClintock (1969) saw the colony on the western shore, but neither succeeded in finding the eastern shore colony. McClintock (1969) also remarked that this area had been searched in vain in 1956 by D. A. Webb and again in 1968.

E. erigena still grows on both the western and eastern shores of Lough Conn. On the western shore (G145.130) the plant grows on cutover bog, particularly on the edges of drains, on desiccated peat hags, and less frequently in wet, disturbed depressions. There are two separate areas where the heather grows in abundance, one on the Errew Peninsula and the other on a headland immediately south of Enniscoe House. The intervening land has been reclaimed for

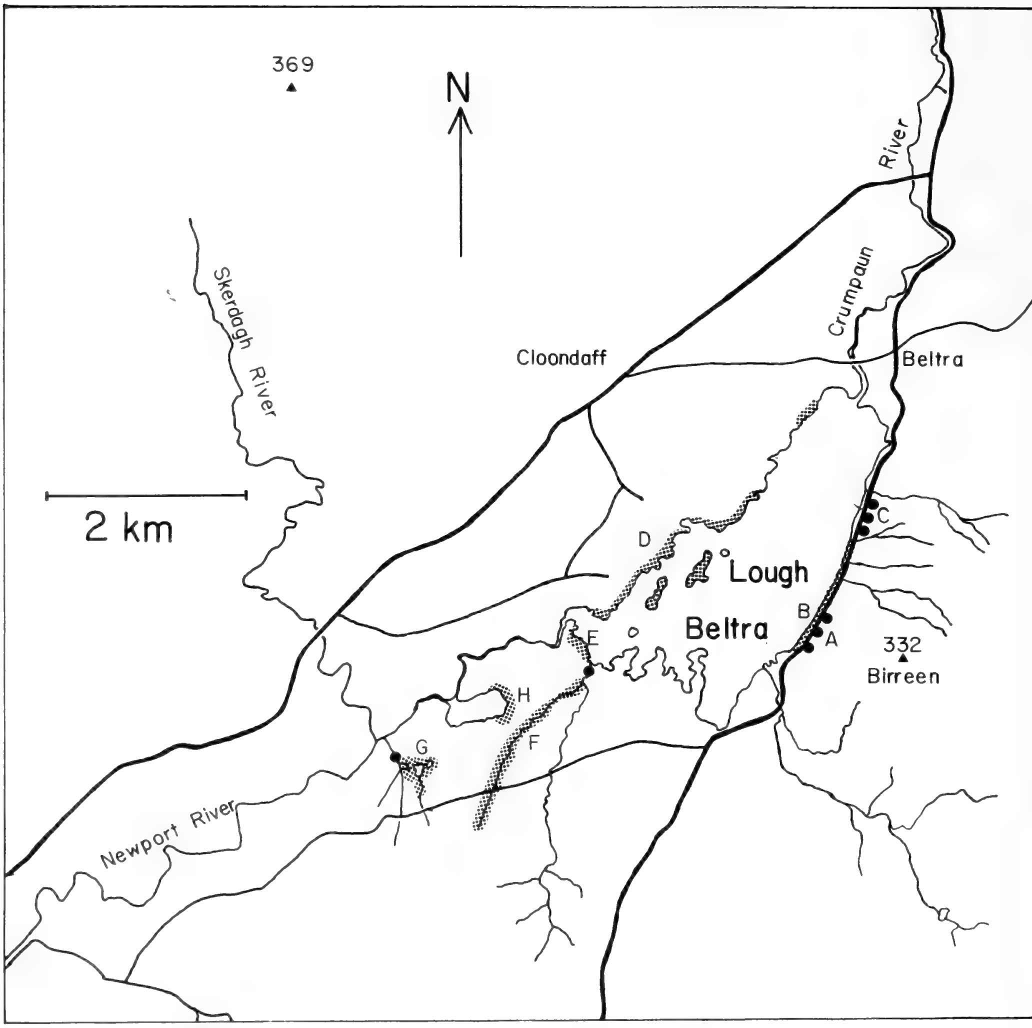

FIGURE 4. The distribution of *Erica erigena* at Lough Beltra, Co. Mayo. A = the plantation site, B = the east shore colony, C = the isolated bushes on the landward side of the road, D = the west shore fringe, E = the southern shore colony, F = the colony on one of the inflow streams on the southern shore, G = the Derrynaloughan Lake colony, H = the Derrynafreva Lake colony. Stippled areas are extensive colonies, solid circles indicate isolated bushes. Mountain peaks are indicated by solid triangles, the associated numbers are heights in metres.

agriculture, and here the heather has been reduced to a few isolated bushes along the shore, forming a connection between the two large populations.

The heather was collected in March 1984 on cutover peat on the eastern shore (G195.147), opposite Annagh Island as reported by Praeger (1900). Two small colonies were found which have a total of seven mature plants, 50–70 cm tall, and an undetermined number of smaller plants. This remains the most easterly station of *E. erigena* in Ireland.

CROSSMOLINA, CO. MAYO

The Crossmolina station, discovered by P. J. O'Hare (McClintock 1969), lies 6 km north of Lough Conn, beside the road from Crossmolina to Killala, near Cloonachoor (G 17.24). *E. erigena* grows abundantly on cutover bog, extending about 100 m on either side of the road. It has colonized dry peat hags, and the intervening wet depressions where the heather forms stout tussocks.

THE LAKE COMPLEX AT FURNACE, CO. MAYO

The precise distribution of *E. erigena* around Furnace (L 975.980) is not obvious from published accounts. Marshall (1900), commenting on its distribution in west Mayo following a visit in 1899, wrote that "it extends eastwards nearly to Newport, but apparently avoids the limestone", presumably referring to the occurrence of the heather near Furnace (Fig. 5), 5 km north-west of Newport. Praeger (1934) also suggested that the heather grew close to Newport. Webb (1952) described a fringe of the heather around Furnace Lough, which he suggested (Webb 1954) resembled the fringe on Loughs Beltra, Carrowmore and "other lakes". Gay (1957) recorded *E. erigena* around most of Furnace Lough, in small quantity at the south-west end of Lough Fadda, and occasionally on the outlet stream between the lough and Carrowsallagh Bridge. He also reported it on the most easterly tributary of the stream running southwards from Bengorm Mountain, and along the abandoned railway embankment in the area. McClintock (1966, 1969) described the distribution of the plant around Furnace Lough and stated that it was "abundant on the fringes of much but not all of this lake and by smaller lakes and streams to the west".

The distribution of *E. erigena* around the loughs at Furnace is shown in Fig. 5. The heather

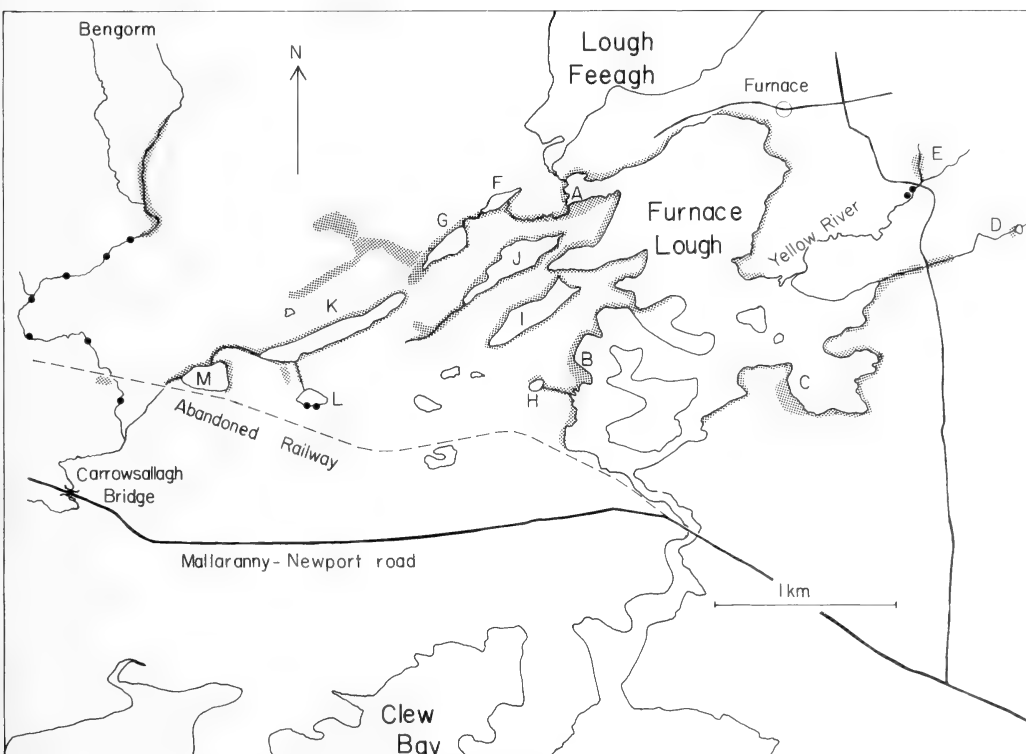

FIGURE 5. The distribution of *Erica erigena* around the lakes near Furnace, Co. Mayo. A, B, C = extensive colonies on cutover peat, D = a small lake with a colony on its western shore, E = the colony on one of the tributaries of the Yellow River, F and G = Loughs Navroony and Naprasky, H = the colony on an unnamed lakelet and the stream entering Furnace Lough, I = Lough Pollagowly, J = Lough Skahaghadrantan, K = Lough Fadda, L = Doontrusk Lough, M = Lough Stirkeen. Extensive colonies are stippled, isolated bushes are indicated by solid circles.

generally forms a distinct fringe along the shore of Furnace Lough, 1–3 m wide, with bushes up to 2 m tall. The heather also covers more extensive areas of cutaway peat on the north-western shore (A in Fig. 5), on the western shore (B in Fig. 5) and again on the southern shore (C in Fig. 5), where colonies extend 30 m inland in places. On the eastern shore of the lough, it occurs as isolated bushes and only forms the typical fringe in sheltered bays. It is absent where the shore is sandy, as at the mouth of the Yellow River. To the east of the lough, south of the Yellow River the heather extends along a small flush eastwards of the road for 40 m. The heather is found further up this flush system, on the western shore of a small lake (D in Fig. 5). *E. erigena* also grows on one of the tributaries of the Yellow River to the north of the road (E in Fig. 5), and on the Yellow River to the south.

Distinct fringes occur on two drains that enter the lough on the west side. In the north-western corner, it grows along the edges of the drain that connects Furnace Lough with Lough Navroony (F) and Lough Naprasky (G). There are isolated bushes and occasional small colonies on the southern shore of L. Navrooney. The heather is found around the entire shore of L. Naprasky; the bushes are small and unevenly distributed in some areas, but form a large colony on the south-western shore, and grow around the edges of, and sparingly on a quaking *Schoenus* flush. The plant also grows extensively on cutover peat to the west of L. Naprasky. The heather has colonized the sides of a second drain, flowing into the south-western corner of Furnace Lough from an un-named lakelet (H) on which the plant is found on the northern shore.

E. erigena grows around other small loughs to the west of Furnace Lough. Isolated bushes are found along the entire shore of Lough Pollagowly (I). There is a distinct fringe, 1–2 m wide around the whole shore of Lough Skahaghadrantan (J) and numerous bushes along the stream entering the lake from the south-west. The heather forms a sparse fringe around Lough Fadda (K) and extends onto cutover bog to the south, and along the drain to Doontrusk Lough (L), where a few isolated bushes are found on the southern shore. The heather grows on the drainage channel connecting Lough Fadda and Lough Stirkeen (M), where it fringes the eastern and northern shores. The plant extends south-westwards along the outflow stream from L. Stirkeen as far as the abandoned railway line.

E. erigena grows on the stream running southwards from Bengorm. It forms a continuous band on the banks of the most easterly tributary and on the main stream as it passes through rough pasture. Only isolated bushes are found where the channel passes through an area of relatively intense agricultural activity, to just south of the abandoned railway line. The plant does not grow on the wooded section of the river bank, north of Carrowsallagh Bridge as suggested by Gay (1957). A small patch is found west of the stream on the steep north-facing railway embankment. It no longer grows at Carrowsallagh Bridge as recorded by McClintock (1969).

MALLARANNY, CO. MAYO

The largest population of *E. erigena* in Ireland is on Bellacragher Bay and Claggan Mountain north of Mallaranny in Mayo. It was first reported by Newman (1839) who stated that it grew in great abundance at "Molyrhany, a cluster of some 12 or 18 cabins". Moore (1852) erroneously stated that in this area one could see "at least a quarter of a million acres in extent covered with the lovely heath". Praeger (1934) gave a more conservative account saying that the heather grew from Mallaranny to the "head of Bellacragher Bay". Webb (1954) rejected Moore's estimate as exaggerated and noted that the heather was common at Mallaranny and on the shores of Bellacragher Bay as far as the northern end of Claggan Mountain. Gay (1957) stated that *E. erigena* was well represented on both sides of the bay, from sea level to 80 m altitude, but was restricted to stream sides and damp valleys higher up the slopes. He indicated that the heather persisted along the river running northwards to Bellaveeny Lodge, until the river entered blanket bog on level ground. He also mapped the plant just east of, and directly behind the village of Mallaranny.

The distribution of *E. erigena* around Mallaranny is shown in Fig. 6. To the east of the village there are colonies (1–2 m wide) along the banks of the Bunnahowna and Murrevagh rivers, from just south of the old railway line to 150 m altitude on the southern flank of Claggan Mountain. These rivers have steep sided valleys that afford protection for the heather which is vigorous and up to 2·75 m tall.

On the slope immediately north of Mallaranny, the heather forms separate colonies in flushes, on the edges of small streams and on cutover peat. The plants are stunted, as a result of exposure and grazing. The heather also occurs on the abandoned railway embankment on the level surface and sloped banks.

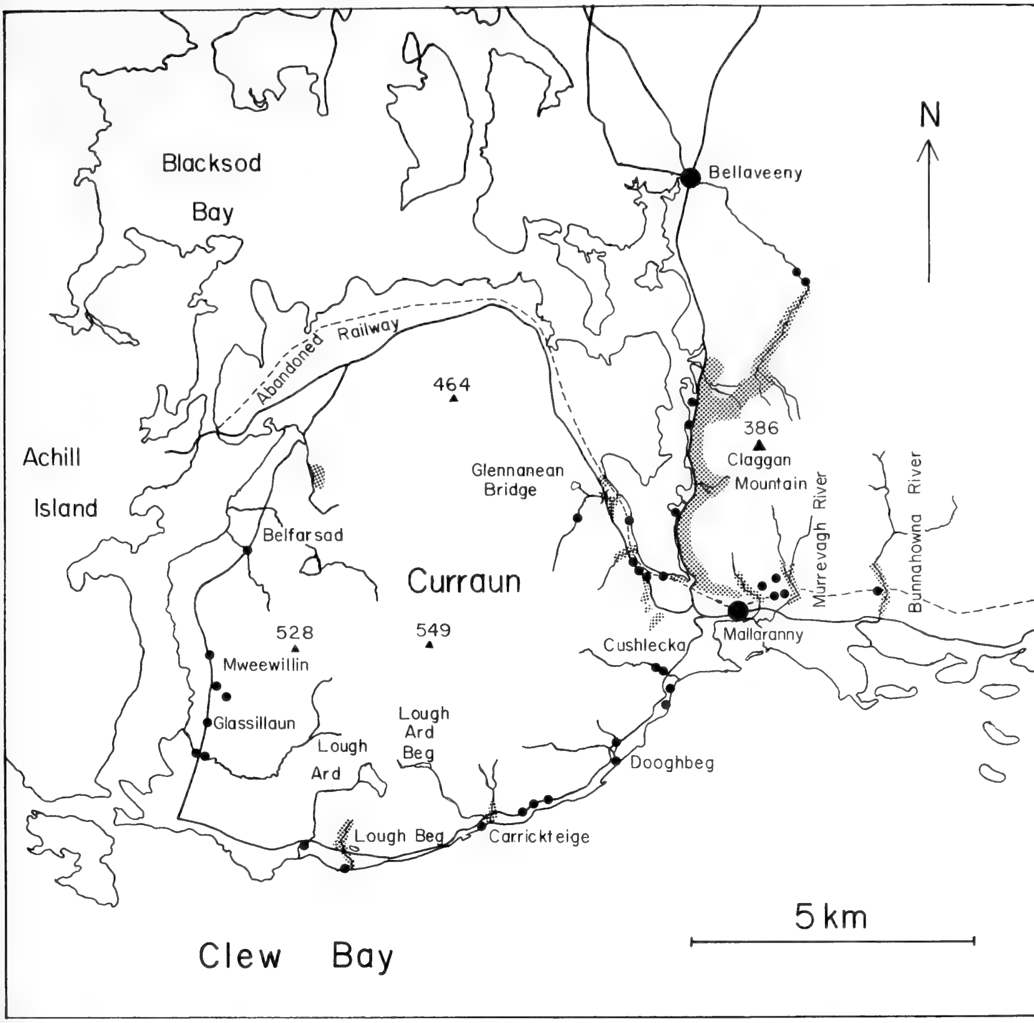

FIGURE 6. The distribution of *Erica erigena* at Mallaranny and Curraun, Co. Mayo. Bellacragher Bay runs northwards from Mallaranny, between Claggan Mountain and the Curraun Peninsula, and connects with Blacksod Bay to the west. Extensive colonies are stippled, isolated bushes are indicated by solid circles. Mountain peaks are depicted by solid triangles, the associated numbers are heights in metres.

West of Mallaranny the plant covers an extensive area on the slopes of Claggan Mountain. This colony, the largest in Ireland, extends for 7 km from the village westwards to the junction of the roads from Achill Island and Bellaveeny, thence along the eastern shore of Bellacragher Bay, and the base of the north-west facing slopes of Claggan Mountain. Colonies exist north-eastwards on the stream flowing towards Bellaveeny, until this enters the deep peat-covered coastal plain north of Claggan. On the eastern side of Bellacragher Bay the heather forms an almost continuous belt from sea level to 50 m altitude, and occupies stream beds and flushes on the hillside up to 150 m altitude.

CURRAUN PENINSULA, CO. MAYO

According to Hart (1883), Curraun was formerly known to botanists as the headquarters of *E. erigena* in Ireland. He reported it on the north-west side of the peninsula, below 50 m altitude. This should probably be interpreted as the western side of Bellacragher Bay (Fig. 6) rather than all of Curraun. Praeger (1934) stated that the heather was abundant on the lower ground of Curraun, but did not indicate if this referred to the whole peninsula. Webb (1952, 1954) gave further descriptions stating that the plant occurred on the western side of Bellacragher Bay and on the southern side of Curraun, where it was abundant beside almost every stream but absent from the intervening bog. Gay (1957) showed colonies on the south coast and on a stream flowing from the lakes marked Ard Loughs on the Ordnance Survey map. He also noted a new station on the west side of the peninsula at Belfarsad. White (1968) presented a detailed vegetation map for Curraun, on which she showed colonies on the eastern side of Bellacragher Bay, three widely separated colonies on the south coast, and another new colony north-east of Belfarsad. McClintock (1969) and Vanden Berghen (1972) did not add to the detail of the earlier reports.

The distribution of *E. erigena* on Curraun is shown in Fig. 6. Along Bellacragher Bay, the heather occurs sporadically, extending from north of Glennanean Bridge to the southern end of the bay. The heather occurs on stream banks, in small flushes, along the abandoned limestone railway embankment, and on abandoned 'lazy beds' above the high water mark. It is also found west of the road, generally confined to the banks of streams and flushes.

On the south coast the heather is found near Cushlecka, on both sides of the road growing on the banks of a stream, and behind a beach of Old Red Sandstone boulders where it has colonized a partially drained peat bog. It also forms two discrete colonies on a stream at Dooghbeg on both sides of the road. At Carrickteige it occurs near the confluence of two streams, one of which flows from Lough Ard Beg. This colony extends to the sea shore, and spreads along the top of a storm beach for about 150 m. It also grows sporadically along the road to the east of Carrickteige. At Lough Beg the plant occurs on the banks of a stream, abundantly on a flushed area on the northern side of the road, sparingly on heavily grazed level ground, and on stream banks between the road and sea shore. It also occurs close to the road further west, on the stream bank which flows down from Ard Lough.

On the western side of the Peninsula the heather grows along the Bunanioo River (south of Glassillaun), at Glassillaun, Mweewillin and between these two villages, and south of Belfarsad. A large colony of impoverished bushes is situated north-east of Belfarsad, on the edge of a stream and on severely grazed and eroded blanket peat.

ACHILL ISLAND, CO. MAYO

More (1889) mentioned that he had seen *E. erigena* on Achill in 1872, and cited two new Achill localities discovered by J. R. Sheridan. Colgan & Scully (1898) listed the sites discovered by Sheridan as Ridge Point and near Dugort (see also Moffat 1898). Praeger (1904) stated that the heather was rare on Achill Island, growing chiefly in the east of the island. He specifically referred to the following locations: the stream behind Valley Strand; from Lough Doo to Bull's Mouth (the Ridge Point site); by the streamlet which rises near Black Lough, from its source to its mouth near Salia; and finally in the west, seen only half way along the northern margin of Annagh Lough (the more easterly of the two lakes named Lough Nakeeroge on Ordnance Survey maps). This particular station is the most westerly in Ireland.

D. A. Webb (see McClintock 1969) recorded *E. erigena* at Mweelin Lough, north-east of Dooega village in 1957; our recent attempts to find the plant in this locality have been unsuccessful. McClintock (1966, 1969) found the plant in just two Achill sites, at Annagh Lough (Lough Nakeeroge East) and at Doogort.

An earlier account appears to suggest that the plant was found at Achill Sound. Moore & More (1866) said it grew "all along Achill Sound, on the shore of the mainland opposite Achill Island". Colgan & Scully (1898) omitted the comma between the two phrases, thereby suggesting that the plant was not found on Achill Island, but was confined to the mainland side (i.e. Curraun).

We have refound only the two sites seen by McClintock, although the other areas were searched thoroughly. At Annagh Lough in the north-west of the island, about 40 bushes were seen in a small bay on the northern lakeshore, and at the western end ten plants were growing along a small stream that flows into the lough.

East of Doogort, and south-west of Lough Nambrack, the heather grows in a distinct colony (200 × 50 m) on cutover bog on the northern side of the road. There are a few bushes in a similar habitat south of the road.

BANGOR-ERRIS, CO. MAYO

The earliest extant collection of herbarium material of *E. erigena* from the Barony of Erris seems to have been by C. Vernon who sent it to David Moore in 1849 (fide **DBN**). However, Mackay (1836b) credited the discovery to John Wynne, and it is he who was acknowledged by Colgan & Scully (1898). Moore (1860) stated that he had traced the plant from Carrowmore Lake in the north-west as far south as Achill Sound, but noted that it was confined to a coastal belt, up to 3 miles [4·8 km] inland, and was most abundant close to the sea. According to Colgan and Scully (1898) Hart found *E. erigena* in two localities on the Mullet Peninsula in 1887. Praeger (1905) gave further information of the distribution on the Mullet, indicating that the plant "haunts the tract west of Belmullet, between the northern hill-bogs and the sands and tillage which extend southwards". Praeger (1934) summarized the distribution of the plant in the Erris area, indicating that it was "widely spread", and was found fringing Carrowmore Lake, and occurred on boggy ground on the Belmullet Peninsula.

Webb (1954) discounted the notion of the plant's widespread occurrence in Erris, stating that he could find it in only two localities other than at Carrowmore, one at a pair of lakelets 3 km north of Gweesalia, the other around Lough Nahelly 3 km further north-west. Gay (1957) mapped the plant at L. Carrowmore; along the road from L. Nahelly to Tristia; at Derrynameel (west of Glencastle Hill), and at the well on the road from Bangor to Belmullet. Gay was unable to find it on the Mullet Peninsula.

P. J. O'Hare noted several new colonies, including two south of the Glenamoy Peatland Experimental Station (O'Hare 1959). He found the species at Muingerroon Bridge (on the road from Glenamoy to Barnatra), at Faulagh (east of Barnatra), both east and west of Derrynameel on the road from Barnatra to Derrycorrib, on the road from Derrycorrib to Bunnahowen, and near Munhin Bridge on the main Belmullet to Bangor Road. He also recorded a number of locations on the Mullet Peninsula, which had been described in general terms by Praeger (1934). McClintock (1966) found another colony above the saltmarsh at Barnatra in 1957.

The distribution of *E. erigena* on the Erris Peninsula is shown in Fig. 7. It covers extensive areas north of Gweesalia, but is generally restricted to places where the peat has been disturbed, including cutover bog, drains at the edge of forestry plantations, and on the edges of drains along roads such as that running north-westwards from Tristia.

The plant is abundant in disturbed blanket bog to the west of the road from Gweesalia to Doolough Lodge, and is confined to drains, the bases of peat banks, and less commonly to water-filled depressions between cutover peat hags. In some of these areas *E. erigena* is the dominant species.

E. erigena is also found to the east of the same section of road, growing on relatively undisturbed deep blanket bog. In this situation the plants are isolated depauperate individuals, and the species never becomes dominant.

At Lough Nahelly there are small plants around the western shore behind a 20 m wide sedge zone. The heather extends onto cutover bog further west of the lough, occurring in drains, at the base of peat banks and on troughs in the cutover bog. Plants are generally small and the species is never dominant.

Further north, it grows in a ditch beside the road from Bunnahowen to Derrycorrib, where there are a few isolated bushes. It is found on the road from Bunnahowen to Derrynameel, growing along the roadside and spreading westwards onto an adjacent cutover bog. Two colonies occur near Derrynameel. At the eastern site the heather has colonized a desiccated peat hag and a wet depression along its edge; the colony extends 30 m from the road, and includes stout bushes up to 1 m tall. At the western site the plant occupies a large area of drained and partially reclaimed peat, which is subjected to heavy grazing by cattle. In this situation there are numerous dead bushes, and the living plants are depauperate.

At Barnatra, the heather occurs on cutover bog on the landward side of the road, and more extensively along a 300 m stretch on the seaward side. Here it generally grows above the level of the highest spring tides, though a few bushes clearly lie below the flotsam line near the upper saltmarsh. Another colony, near Faulagh, covers an area some 20 × 5 m on flushed cutover peat. This site is heavily grazed by sheep and cattle. Further east about 40 bushes grow on grassy, cutover peat on the hillside north-east of Muingerroon Bridge.

The stations reported from south of Muingerroon Bridge, and south of the road opposite the

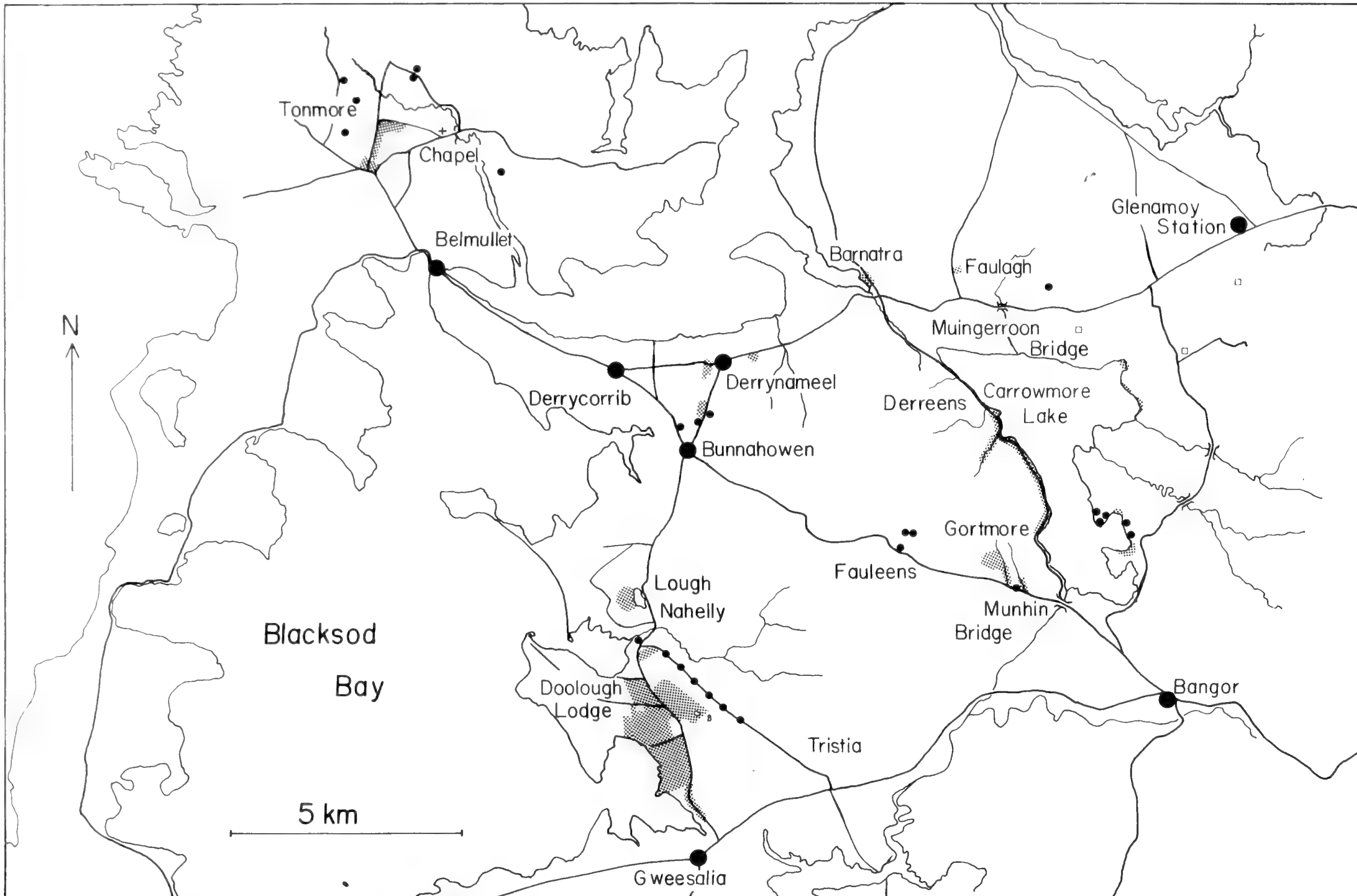

FIGURE 7. The distribution of *Erica erigena* on the Bangor-Erris Peninsula, Co. Mayo. Extensive colonies are stippled, isolated bushes are indicated by solid circles. The open squares indicate three sites recorded by P. J. O'Hare which were not located during our survey.

Glenamoy Research Station were not found during our survey. The two latter sites, described by O'Hare (1959), are in areas now covered by mature conifer plantations.

The populations at Carrowmore Lake are depicted in Fig. 7. Many of the earlier accounts are vague, but Gay (1957) mapped the well-known fringe on the western shore, the colony on the stream entering the lough on the western side, and another in the south-eastern corner. The extensive colony on the north-eastern shore has not been reported before. The western shore colony stretches almost uninterrupted for 3 km from Derreens to Gortmore, and varies in width from 1–10 m; the bushes are 50–100 cm tall. The plants grow on shallow sandy peat and rocky mineral soil. O'Hare (in McClintock 1969) observed a marked expansion in this population over 25 years ago when the water-level was lowered and seedlings colonized the exposed lake bed. The heather also extends up the edge of the stream entering the lough on the western shore to an altitude of 90 m. The species covers extensive areas of soligenous peat on the northern and southern corners of the large bay lying due east of Gortmore. There are isolated stunted bushes on the shore between these two colonies, and on the northern headland of the bay. In the north-eastern corner of the lough the plants form a sparse colony along much of the shore; here it is generally small (15–40 cm) and grows below the obvious high-water drift mark.

The heather is found on the main Bangor to Belmullet road, just west of Munhin Bridge. It grows along the edge of two small streams that flow in the depressions between cutover peat banks, and extends about 250 m from the road. The heather also covers an area of 200 × 200 m on a large area of flushed, intact peat to the west of the more westerly of the streams. At Fauleens, a few plants grow along a stream north of the road and numerous bushes grow on cutover peat along the base of the hill north of this stream.

On the Mullet *E. erigena* is found in the general vicinity of Tonmore. It grows on cutover bog, colonizing the elevated dry peat hags, drain edges, and embankments on the edge of roads. It forms an extensive colony along a small road running westwards from a chapel (marked on the Ordnance Survey map) to Tonmore, and then southwards to the junction of five roads. The other colonies on the Mullet are small and isolated. In every case, plants are small and weak and the species is rarely the dominant one in the vegetation.

CONCLUSIONS

The distribution of *Erica erigena* in Ireland must be regarded as very local, although it is more widespread than has been previously reported. Several new stations for the species have been located and a number of poorly known sites refound. The conservation status of the heather in western Ireland would seem to be secure at the present time. The major sites do not appear to be threatened, although some are overgrazed. The heather seems to be increasing in the cut-over peat sites, as it grows vigorously along desiccated peat hags and flat peat disturbed during cutting. However, the heather's long term prospects are not so guaranteed. It will probably survive in its lakeshore habitats where interference is unlikely, but it will soon be threatened where it grows at the edge of extensive blanket peatland areas, and on the cutover peat sites. In recent years there has been extensive exploitation of blanket peat in the west of Ireland (Doyle 1983), where there has been extensive reclamation for forestry and some commercial exploitation for fuel. Forestry plantation is a serious threat as it is carried out at a rate of some 5000 ha per year (Dillon *et al.* 1976), and once established tends to obliterate the native peatland vegetation entirely (Doyle & Moore 1982). If this heather is to survive in these peatland edge and cutover sites a proper conservation plan will be required.

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We wish to thank Miss M. J. P. Scannell, D. McClintock, D. Small and Professor D. A. Webb for discussion on the distribution of *E. erigena* in western Ireland. We acknowledge the assistance provided by P. J. O'Hare (Assistant Director, Agricultural Institute, Oak Park, Co. Carlow), who allowed us to consult his records of *E. erigena* on the Bangor-Erris peninsula. We thank Dr N. Kirby and D. Hogan of the Connemara National Park for stimulating discussion and practical help at Roundstone. This work forms part of a Ph.D. thesis carried out at the Botany Department, University College Dublin by P.J.F. We acknowledge the financial support of the Botany Department, the Irish Department of Education and the Office of Public Works.

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Short Notes

THE HERBARIUM OF BOURNEMOUTH NATURAL SCIENCE SOCIETY

A recent visit to the museum of this Society resulted in the discovery that the returns on which the entries for its herbarium (**BMH**) in Kent (1957) and Kent & Allen (1984) were based were misleading in certain important respects.

The herbarium consists in fact of just two separate collections: a Dorset one formed in 1910–18 by Charles Baylis Green, and a much larger one representative of the British Isles as a whole. The first of these, mounted on small and rather flimsy sheets, contains material from many parts of v.c. 9, not (as stated) from the Isle of Purbeck alone, and extends to certain critical groups (though not, for example, *Rubus*), the sheets of which carry determinations by the respective national referees of the inter-war period. Oddly, though, it would appear not to have been consulted by Good (1948) when compiling his checklist of the flora of the vice-county.

The other collection, described simply as "formed by members", seems to be basically the combined herbarium of T. A. & C. Cotton, which has hitherto been untraced. This doubtless came to the Society in or around 1925, the year of death of both of these collectors, who latterly had Bournemouth connections. Thomas Atkinson Cotton was Honorary Secretary for several years of the Watson Botanical Exchange Club, of which his wife Charlotte was a long-standing member as well, and many of their sheets, as expected, have labels that bear the stamp of that. Not all the ones from other collectors, however, can be from that source and some of these the Cottons may have bought, for in at least certain other botanical directions they are known to have spent generously. Possibly that is how the Society comes to be the possessor of numerous sheets of W. H. Purchas, the joint author of the *Flora of Herefordshire* (particularly valuable, as his main collection was destroyed in the wartime bombing of Bristol City Museum). R. V. Sherring, on the other hand, another collector who is substantially represented, was a Vice-President of the Society, so his specimens must be presumed to have been acquired directly and independently. That was definitely the case with two other sets of specimens that have been incorporated into this general Society collection. One of these consists of various common *Rubus* species from the Bournemouth district which the Rev. W. Moyle Rogers is on record as having donated to the Society in 1909–10, the other of what remains of the presumably once much more extensive herbarium of John Frederick Rayner, author of *A supplement to Frederick Townsend's Flora of Hampshire and the Isle of Wight* (1929). For, sad to say, the whole of the Society's general collection was drastically thinned at some time in the 1930s or 1940s – by a misguided honorary curator who deemed it superfluous for any taxon to be represented by more than a single sheet (N. Douglas Simpson pers. comm. 1951). Among the many specimens destroyed Rayner's appear to have featured in disproportionately large numbers, probably because the sheets on which they are mounted are an awkwardly smaller size than the rest. That they were also collected at more recent dates may also have been a factor. Unfortunately, as a result, most of the vouchers for Rayner's more interesting records have thereby been lost irretrievably.

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ATRIPLEX LITTORALIS NEW TO SHETLAND

During fieldwork in Shetland, v.c. 112, in August 1985, some plants of *Atriplex littoralis* L. were discovered near Boddam (GR 411/397.155) in S. E. Mainland. This discovery extends the range of this species by about 240 km north of its previously mapped limits in the British Isles (Taschereau 1985).

The plants were growing in tall, ungrazed and rather rank vegetation, mainly of *Elymus repens* (L.) Gould and *Juncus gerardii* Loisel., at a low level just above the shore, and very close to the lower limit of angiosperm cover. Four plants were seen; two were collected and pressed (one deposited at **BM** and one with W. Scott, Scalloway for incorporation in **ZCM**, Lerwick). These plants have very compact inflorescences at anthesis; low magnification stereo microscopic study showed apparently normal pollen formation. In October, the site was revisited independently by W. Scott and the writer, and further plants were found in the same limited area. At this time, the plants were much taller and in fruit, some of which dropped easily from the stems when touched. W. Scott examined some fruits and was able to confirm the earlier identification based on foliage characters.

The very limited area occupied by *A. littoralis* near Boddam and its previous omission from Shetland records (apart from the inconclusive and unsupported reference to this species by Hilliam (1977)), suggest that it may be a recent newcomer to the islands.

The northern limit in Britain (Taschereau 1985) lies at approximately 57° 40′ N., corresponding very closely with the northern limit for frequent occurrences as a native in the Skagerrak and Gulf of Finland in the Baltic (Hulten 1971), suggesting that common climatic conditions limit extensive establishment in the north, although there are scattered locations for *A. littoralis* up the west coast almost to the extreme north of Norway, perhaps as a result of the effects of the Gulf Stream. The species is absent from Faeröe and Iceland (Aellen 1964).

If *A. littoralis* has indeed recently arrived in Shetland from a source in mainland Britain, then one might expect it to be found in the south of the archipelago. For climatic reasons too, one might expect a more thermophilous species to gain a foothold in the extreme south of Shetland. In this connection, the comments by Bullard (1985) about Orkney are relevant. She writes that the "apparently unlikely *Atriplex littoralis* turns up occasionally as strand-line seedlings which fail to overwinter", but she does not refer to the survival of any mature plants.

In conclusion, it is not at all easy to predict the future of the Boddam colony, bearing in mind the spasmodic fluctuations in population size of this species at Milford Haven in S. Wales (Dalby 1969, 1971), the often temporary nature of shoreline habitats and the location of the site rather north of the general limit for *Atriplex littoralis*, but its chances may be promising if future winters are not too severe. W. Scott, however, is inclined to suspect that the Boddam colony has been there a long time, overlooked, and is likely to persist unless its habitat is destroyed.

ACKNOWLEDGMENTS

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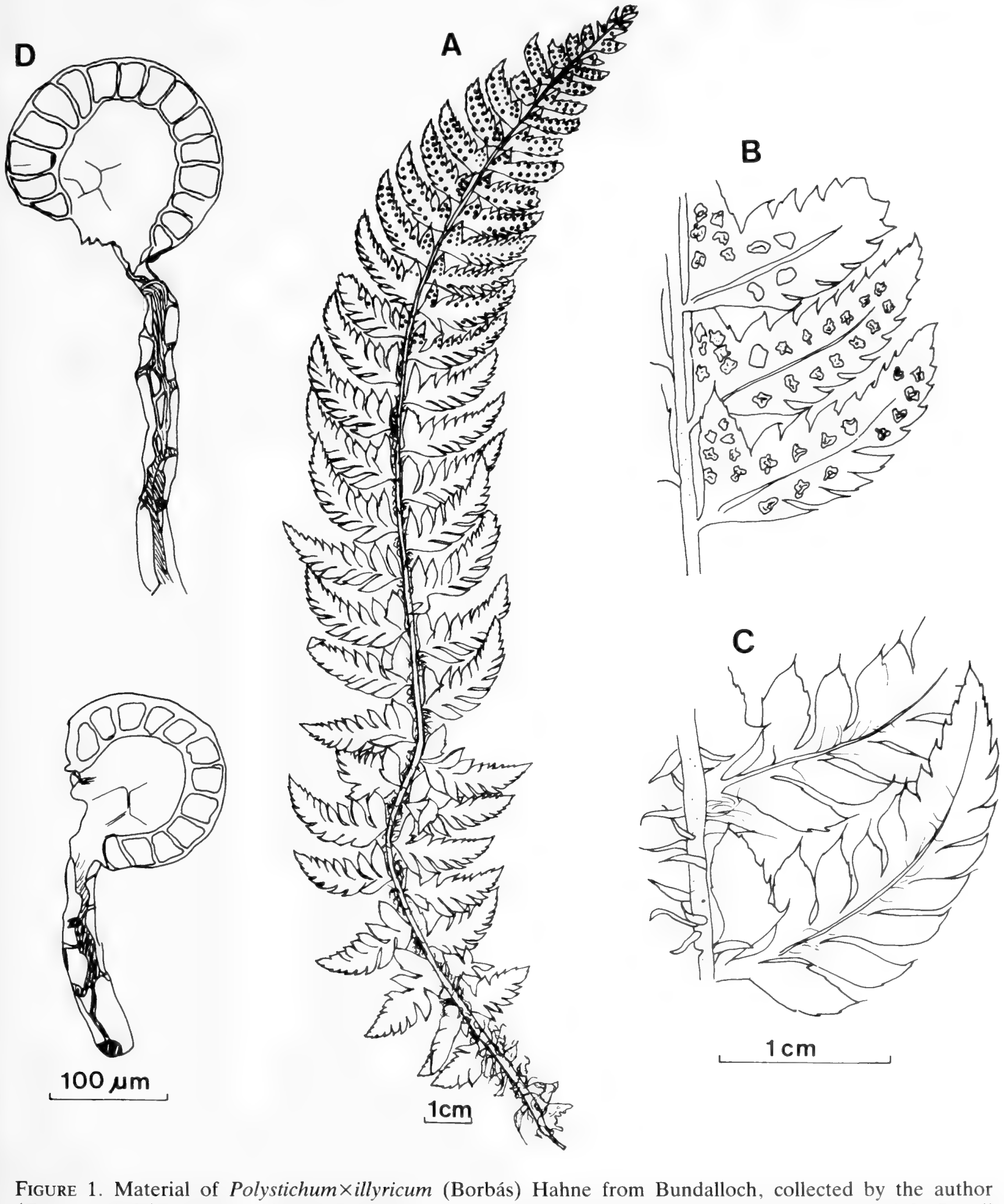

FIGURE 1. Material of *Polystichum×illyricum* (Borbás) Hahne from Bundalloch, collected by the author (*Ferguson 1785*) and housed in the University of Antwerp Herbarium (**RUCA**). A. Outline of frond; B. Detail of three fertile pinnae; C. Mature pinnae (9th and 10th pinnae from base); D. Empty sporangia. Illustration by A. Torfs.

AN ADDITIONAL SITE FOR *POLYSTICHUM×ILLYRICUM* (BORBÁS) HAHNE IN NORTH-WESTERN SCOTLAND

In the course of a field trip in August 1984, an unusual shield-fern was encountered in the Glennan Valley, 1 km east of Bundalloch, v.c. 105 (GR 18/906.276). It was growing on a relatively dry site about 40 m above sea-level. One frond, 27×5 cm, with thirty pairs of pinnae, was collected for further examination (Fig. 1).

The presence of sori ruled out the possibility that one was dealing with an immature frond of *Polystichum aculeatum* (L.) Roth which, while not encountered in the Glennan Valley, is recorded from the same 10-km square (Jermy *et al.* 1978). Likewise, *P. lonchitis* (L.) Roth, while still unrecorded from the Glennan Valley, is known from two of the neighbouring squares. However, in this case the species is only simply pinnate. There seemed to be no alternative but to assume a hybrid origin. This was confirmed by examining the sori. While the indusia and some of the sporangia were well developed, the sporangia proved to be empty (Fig. 1). The spores had aborted. Since the nearest site for *Polystichum setiferum* (Forsk.) Woynar is more than 25 km away, the putative parents are probably *P. aculeatum* and *P. lonchitis*, i.e. one is dealing with the hybrid *P.×illyricum* (Borbás) Hahne. Since *P.×illyricum* is practically indistinguishable from *P.×lonchitiforme* (*P. lonchitis×setiferum*) on morphological grounds, this identification must await confirmation in the form of a chromosome count.

Although *P. aculeatum* and *P. lonchitis* are largely sympatric in Scotland (Jermy *et al.* 1978), the hybrid has so far only been reported from a single site, i.e. Inchnadamph (Stirling 1974), although it has also been recorded from Co. Leitrim, v.c. H29 (Page 1982). The present record confirms the surmise (Sleep & Synnott 1972; Page 1982) that this hybrid could be found in other areas of the British Isles.

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FURTHER NOTES ON *DACTYLORHIZA INCARNATA* SUBSP. *CRUENTA* IN SCOTLAND

In a recent paper (Kenneth & Tennant 1984), we announced the discovery in 1982 of *Dactylorhiza incarnata* (L.) Soó subsp. *cruenta* (O. F. Mueller) P. D. Sell from West Ross, v.c. 105, at that time new to mainland Britain, and gave some descriptive information about the plants and details of their habitat. Since that time, further field work has been undertaken and the data obtained during 1984 have now made it desirable to provide some additions and modifications to the original information published in that paper.

Flower measurements were not carried out in 1982, and 1984 measurements are therefore given in Table 1. Studies carried out on the different populations in 1984 showed that the uppermost population did not have larger flowers as suggested in our paper (Kenneth & Tennant 1984) and also the general appearance and colour of the flowers in this population was barely distinguishable from those of the lower populations, unlike the situation found in 1982. The flower colour and markings were well within the range of *D. incarnata* subsp. *cruenta* from Europe, and probably

TABLE 1. CHARACTERS OF *D. INCARNATA* SUBSP. *CRUENTA* IN WEST ROSS (1984 MEASUREMENTS)[a]

Height (cm)	7.5–21 (14)
Length of longest leaf (cm)	3–9 (5.4)
Maximum width of longest leaf (cm)	0.8–2.0 (1.1)
Ratio leaf length to width	4.91
Length of inflorescence (cm)	2.5–5.8 (3.5)
Number of flowers in spike	5–20 (12)
Labellum length (mm)	5.5–7.5 (6.4)
Labellum width (mm)	5.0–8.0 (6.4)
Spur length (mm)	5.0–7.0 (6.0)
Spur width (mm)	2.0–3.0 (2.5)
Length of bract peripheral cells (μm)	36–67 (52)

[a] Field measurements made on 26 plants in June 1984, being additions and modifications to the original, 1982 data (Kenneth & Tennant 1984). Mean values are shown in brackets.

also from Ireland (R. Bateman pers. comm.). The peak flowering period in 1984 was also earlier than in 1982, being from mid- to late June, and in 1984 there was no significant difference in flowering state between the uppermost and lowermost populations. In 1982, flowering in the uppermost population extended well into the second half of July. It is therefore likely that the differences observed between these populations in 1982 were due to climatic factors as we previously suggested, such as late snow-lie affecting only the upper population in that particular year.

The main features which distinguish the West Ross plants from other variants of *D. incarnata* in Britain are the distinctive, largish, violet-brown spots on both sides of the expanded sheathing leaves, the heavy streaking or flecks of anthocyanin on the ridges or veins of the upper stem, bracts and ovaries, and the labellum shape and pattern (Fig. 1). The West Ross populations of subsp. *cruenta* differ in general appearance in all these respects from *D. incarnata* (L.) Soó subsp. *pulchella* (Druce) Soó, which was present amongst one of the populations examined; subsp. *cruenta* also differed from subsp. *pulchella* at the same locality because of the slightly less erect, less channelled, sheathing leaves in the former and, in the case of few-flowered plants, because of the more spreading ovaries, giving subsp. *cruenta* a laxer floral spike. Additionally, the labellum of subsp. *cruenta* was more distinctly trilobed, with a more intense pattern of distinctive, violet-coloured loops, rings and dots (Fig. 1).

The shape and dimensions of the bract peripheral cells agree closely with published values for the taxon, being rounded and barrel-shaped in outline, and not at all angular as is typically found in tetraploid taxa.

Approximately 7.5% of the West Ross plants of subsp. *cruenta* examined had unspotted leaves. It was noted, however, that such plants deviated slightly in other characters from typical plants with spotted leaves, and that they were present only in the single population where *D. incarnata* subsp. *pulchella* also occurred. It is conceivable that such plants might have been inter-subspecific hybrids with subsp. *pulchella*, rather than mere morphs.

In spite of the number of interesting plants listed in Table 2 of the original paper (Kenneth & Tennant 1984), which described the habitat, several were in fact noted in the nearby vicinity, whereas those species which were more closely associated with the dactylorchids showed that the habitat seemed to differ little from other *Schoenus nigricans* - *Molinia caerulea* - *Scirpus cespitosus* - dominant communities which are so widespread in the north-western Highlands. The majority of the dactylorchids occurred in flushed grassland where the soil pH was nearly neutral to mildly alkaline. Additional species found to be present but not listed in the original paper (Kenneth & Tennant 1984) included *Ranunculus flammula*, *Myrica gale*, *Dactylorhiza incarnata* subsp. *pulchella*, *Sphagnum* sp. and *Breutelia chrysocoma*.

Specimens and photographs of *D. incarnata* subsp. *cruenta* from West Ross have been placed in **E**.

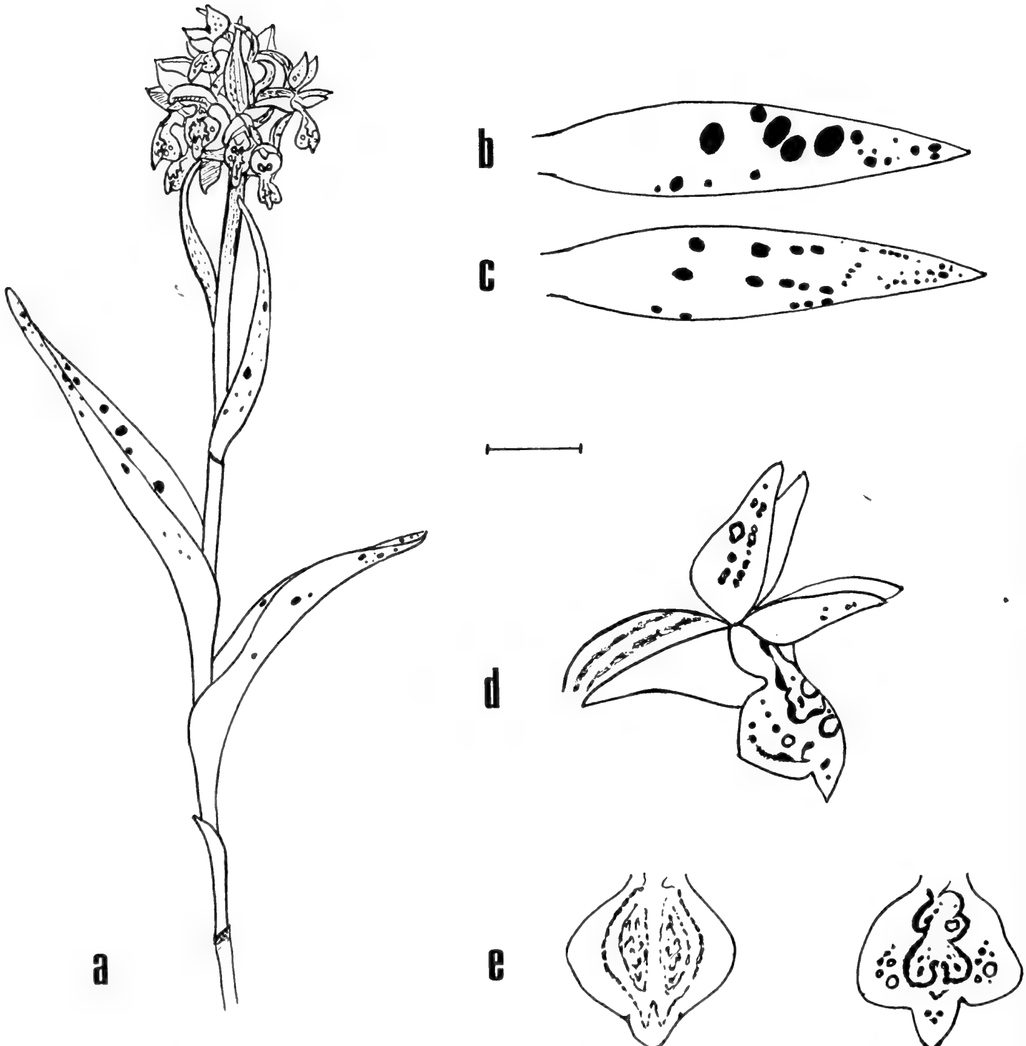

FIGURE 1. *D. incarnata* subsp. *cruenta* from West Ross.
(a) Whole plant; (b) sheathing-leaf illustrating leaf spotting on upper surface; (c) sheathing-leaf illustrating leaf spotting on lower surface; (d) flower illustrating steaked ovary, spur, and markings; (e) labellum shape (pressed) and markings, subsp. *cruenta* (right) compared with subsp. *pulchella* (left). Scale bar=10 mm (a–c), 3 mm (d, e).

ACKNOWLEDGMENT

We should like to thank R. H. Roberts for provision of data on the bract peripheral cells and general comments on the text.

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ALLIUM AMPELOPRASUM L. IN ANGLESEY

Allium ampeloprasum L. is a native of southern and western Europe, with its main distribution centred around the Mediterranean basin. It is a variable species within which three morphologically differentiated taxa are usually recognized. These are now treated as varieties: var. *ampeloprasum* with a dense, globose umbel of flowers (up to 500); var. *babingtonii* (Borrer) Syme, with an irregular umbel having few flowers and numerous large bulbils (usually 8–12 mm) and often with small, secondary umbels borne on longer pedicels; and var. *bulbiferum* Syme, with fewer, smaller bulbils (6–8 mm) in the umbel (Stearn 1980). However, there is still no general agreement on the taxonomy. Although var. *babingtonii* was formerly treated as a distinct species, *A. babingtonii* Borrer, it is now generally regarded as a variety of *A. ampeloprasum*. Opinions differ regarding var. *bulbiferum*, which Clapham *et al.* (1981) now do not distinguish from var. *ampeloprasum*.

On the Continent, where most records seem to refer to var. *ampeloprasum* and only a few to var. *bulbiferum*, the plants are found on disturbed ground (Stearn 1980). In the British Isles, however, it has been recorded from a variety of habitats, mostly around the coast from the Isles of Scilly, Cornwall, Guernsey, Steep Holm (Somerset), Flat Holm and Porth Kerry (Glamorgan) to Tenby (Pembrokeshire) (Clapham *et al.* 1962; Ellis 1983). The Channel Island plants appear to belong to var. *bulbiferum*, which is also recorded from Île d' Yeu, Vendée, on the western coast of France (Stearn 1980). In Cornwall, where both var. *ampeloprasum* and var. *babingtonii* are recorded (the latter being much the more frequent) the plants occur mainly on roadside verges, Cornish 'hedges', waste ground and occasionally in more natural habitats such as sandy coastal marshes (Margetts, pers. comm. 1986). In the Isles of Scilly, where only var. *babingtonii* occurs, it is found on hedgebanks, field borders, cliffs, dunes and rough bushy places (Lousley 1971). In Ireland, where, similarly, all populations belong to var. *babingtonii* (Scannell & Synnott 1972), they are found mostly on the islands along the western and north-western coasts, usually growing in rock crevices and sandy places (Praeger 1934).

Its status in the British Isles is uncertain: while some authorities consider it to be native (Praeger 1934; Scannell & Synnott 1972), others think it more probably an ancient introduction (Margetts & David 1980; Ellis 1983).

All previous Welsh records of *A. ampeloprasum* refer to var. *ampeloprasum*. The habitat is described as rocky sea coasts, but only on Flat Holm, where it was first recorded in 1837, has it been confirmed recently (Ellis 1983).

The occurrence of this species near South Stack on Anglesey is therefore of some significance. The exact date of its discovery is uncertain, but Mr D. B. Hornby (pers. comm. 1985) appears to have been the first to notice it in the early 1970s. He recalls seeing about five or six plants in flower then, which he took to be a kind of "wild onion". Records of the species first appeared in the Royal Society for the Protection of Birds' South Stack Warden's *Annual Report* about 1976, but it was not until 1983 that one of us (R.H.R.) became aware of the locality. This was visited in the autumn of that year to confirm the identification and determine the size of the population, which was found to be 43 flowering plants with a smaller number not flowering.

In August 1985, only 22 flowering plants could be seen, again with a smaller number not flowering, but a number of broken stems suggested that some flower-heads had been collected. Additionally a further small group of plants (four in all, but only two of them flowering) was found about 50 m away from the original site.

The South Stack plants have bulbs about 2.5 to 3.5 cm across with several offsets inside the tunic. Their flowering stems are about 120 cm tall, with broad, grey-green, linear leaves around 36 cm long and 3 cm broad at the base. The globose umbels, about 5 to 6 cm across, have a large number of densely-packed flowers, their corollas tinged with pale mauve, but no bulbils. The stamens are only slightly exserted, and the antheriferous points of the filaments are almost as long as the undivided part. It seems, therefore, that these plants, like those from all other Welsh localities, can be referred to var. *ampeloprasum*.

Although not close to habitations, the plants have no appearance of being indigenous in this locality. In the original site they grow within an area of a few square metres in a humus-filled hollow at the edge of a field and close to its boundary wall, which provides the plants with some degree of shelter from the wind. The habitat of the second group of plants is similar and the main associated species are indicative of uncultivated headlands and nutrient-rich soils – *Achillea millefolium*, *Anthriscus sylvestris*, *Arrhenatherum elatius*, *Cirsium arvense*, *Dactylis glomerata*, *Festuca rubra*, *Galium aparine*, *Heracleum sphondylium*, *Holcus lanatus*, *Lathyrus pratensis*, *Pteridium aquilinum*, *Rubus fruticosus* agg., *Rumex acetosa* and *Urtica dioica*.

How this *Allium* came to South Stack is a matter of conjecture, for there is no obvious local source of either seed or bulbs. It was once gathered from Bangor, Caernarvonshire, in 1876, but has not been recorded there since and is now considered to have been an introduction (Ellis 1983). The fact that Griffith (1895) does not mention this record in his *Flora* is perhaps significant.

Clearly the small population at the South Stack locality is a fragile one. The flower-heads are often picked by local people and this can result in dislodgement of the loosely-rooted bulbs, and it is hoped that anyone visiting this site will refrain from picking any of them.

Hopefully this population of *A. ampeloprasum* will continue to flourish, for its occurrence on Anglesey, and in particular in the environs of South Stack, adds another interesting species to a locality long noted for its rarities.

ACKNOWLEDGMENT

We wish to thank Dr J. S. Parker for his useful comments.

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TYPIFICATION OF *HIERACIUM AMPLEXICAULE* L.

Hieracium amplexicaule was described by Linnaeus on page 803 of *Species Plantarum* in 1753. The diagnosis *Hieracium foliis amplexicaulibus cordatis subdentatis*, *pedunculis unifloris hirsutis caule ramoso* is taken from page 387 of the *Hortus Cliffortianus* (1738) with only the minor change of *vix dentatis* to *subdentatis*. In the herbarium of Hortus Cliffortianus at the **BM** is a single sheet labelled *Hieracium folio caulina amplexico* Triumfett. and in an unknown hand *amplexicaule*. This specimen is in agreement with the diagnosis and I designate it as the lectotype of *Hieracium amplexicaule* L. It belongs to the taxon described by Zahn (1921–1923) as *H. amplexicaule* subsp. *amplexicaule* and by Pugsley (1948) as *H. amplexicaule*. The synonym *Hieracium pyrenaicum longifolium amplexicaule* Tournef., *Inst.* 472, given by Linnaeus, is probably referable to the same species. His *β Hieracium pyrenaicum rotundifolium amplexicaule* Tournef., *Inst.* 472, may well be a different species, possibly *H. speluncarum* Arvet-Touvet. The specimen in the Linnaean Herbarium (**LINN**), *Savage Cat.* 954.33, labelled *amplexicaule* in Linnaeus' hand, belongs to the same taxon as the lectotype in Hort. Cliff.

Hieracium amplexicaule is native on mountain rocks, mainly calcareous, from Spain and S. France to Austria and Hungary. It is naturalized on old walls further north. Its distribution as a naturalized plant in the British Isles has been discussed by Bevan (1982, 1983).

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PELORIC FLOWERS IN THE TRIBE ANTIRRHINEAE (SCROPHULARIACEAE)

Flowers of European species of the tribe Antirrhineae (including *Anarrhinum* Desf., *Antirrhinum* L., *Asarina* Miller, *Chaenorhinum* (DC.) Reichenb., *Cymbalaria* Hill, *Kickxia* Dumort., *Linaria* Miller and *Misopates* Rafin.) are normally highly zygomorphic (bilaterally symmetrical) but occasional plants have a more or less actinomorphic (radially symmetrical) corolla. This phenomenon has been given the name 'peloria', the subject of a dissertation published by Linnaeus (1749), and was known to pre-Linnaean authors. Such plants were sometimes treated as belonging to a different genus from those with zygomorphic flowers (Rafinesque-Schmaltz 1840), while other authors regarded them as distinct species, varieties or insignificant forms. Most authors today give them no formal taxonomic recognition but regard the plants as monstrosities or genetic mutants. Peloric flowers occur in other Scrophulariaceae such as *Digitalis* L. (Arber 1932), and some American species of the tribe Antirrhineae (particularly *Lophospermum* D. Don, *Maurandya* Ortega and *Rhodochiton* Otto & A. Dietr.) have corollas that normally approach the actinomorphic state.

Peloric flowers do not represent a single morphological state. In *Linaria vulgaris* Miller, variants with no spur ("anectaria" of Linnaeus (1749)) occur in addition to those with five spurs ("quinquenectaria" of Linnaeus (1749)). Indeed, in a single specimen of *Linaria* or *Kickxia*, it is sometimes possible to find corollas with one, three, five or no spurs (cf. Chavannes 1833: plate 8). Plants of *Linaria purpurea* (L.) Miller, both native in Sicily and naturalized in Britain, are occasionally encountered with single inflorescences containing mostly normal zygomorphic flowers but also scattered peloric flowers.

Considerable research on *Antirrhinum majus* L. (cf. Stubbe 1966) has resulted in one of the best genetically documented species amongst flowering plants. The inheritance of peloric flowers in this taxon is reasonably well understood, though other species of the tribe have scarcely been studied. Development of peloric flowers was originally thought to be controlled by a single recessive gene and it is interesting to note that Darwin (1868: 46) published a report of crossing true-breeding peloric plants with normal *Antirrhinum majus*. Dominance of the zygomorphic form over the peloric form, and the expected 3:1 ratio of zygomorphic to peloric plants in the second generation, are apparent from the numbers of offspring recorded by Darwin, though this was years before the classic genetic work of Mendel (1866) was widely known. It was later shown that linked multiple alleles were involved in the production of peloric flowers, especially those of the *Cycloidea* (or *Radialis*) series (Kuckuck 1936). It is not surprising that genes controlling zygomorphy of the corolla should be linked, as even small differences in the structure of the Antirrhineae corolla leads to reproductive isolation, owing to the behaviour of the normal pollinators (Mather 1947). Through hybridization, progeny of other species of *Antirrhinum* have been obtained with peloric flowers (Brieger 1935). The most familiar results of breeding plants with peloric flowers are the "Penstemon-flowered" garden snapdragons.

A simple genetic basis for peloric flowers does not account for situations where only a few flowers in an inflorescence are peloric. It is possible that the development of the corolla could be influenced by external factors such as insect predation or viral infection. Viral infection has been attributed as the basis of plants known as *Cymbalaria toutonii* A. Chev. (cf. McClintock 1982), generally considered to be referable to *C. muralis* P. Gaertner, B. Meyer & Scherb. though with very different foliage and a smaller corolla than the normal species. It is also possible that genes controlling the zygomorphic development of the flower might be labile, with random mutation accounting for inflorescences with varying symmetry of the corollas. Perhaps the best known labile genes in *Antirrhinum majus* belong to the *Pallida* series and control the flower colour. Back mutation results in a corolla with 'broken' coloration which varies from one flower to another and some strains of garden snapdragon have this patterning. There is a labile allele in the *Cycloidea* series which results in the peloric corolla reverting to the normal zygomorphic form.

Much is still unknown about peloric flowers in the Antirrhineae, but with such a long history of morphological observation and the detailed genetic investigation of *Antirrhinum majus*, species of the tribe would provide ideal experimental subjects for investigation into the development and control of zygomorphy in flowering plants.

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Book Reviews

Studies in plant demography. A Festschrift for John L. Harper. Edited by J. White. Pp. xxxiii+393. Academic Press, London. 1985. Price £44.00 (hardback; ISBN 0–12–746630–4); £21.00 (paperback; ISBN 0–12–746631–2).

This volume celebrates the 60th birthday of one of the most influential plant ecologists of the last 30 years. Professor John Harper has long been at the forefront of the integration of plants into the science of population biology, previously the domain of the zoologist. He and his numerous students and co-workers have investigated births, deaths, numbers, survivorship and growth patterns in plant species, in order to provide quantitative assessments of evolution through natural selection. The material in this book thus falls rather outside the systematics fields that concern most B.S.B.I. members, but provides a valuable introduction to, and summary of, an important area of botany. Harper's philosophy has been strongly influenced by Charles Darwin, and here we are certainly on common ground. This Festschrift includes contributions on life histories, reproductive biology, effects of neighbours, plant-animal interactions, weed ecology, and aspects of agriculture and conservation. Weeds, which Harper himself once described, in characteristically impish manner, as "slightly improper material for biological studies", are a major theme, not least with reference to the need to study invasions of alien weeds – very "improper" material indeed, but meat and drink (of one sort or another) to many of us! There are items of interest for all here, from *Eupatorium* to emus, and there is also a useful bibliography of Harper's publications.

The contributors emphasize the use of quantitative observations, experiments and analyses in plant ecology, which Harper has done much to transform into an exact science. Nevertheless, they and we should not forget that the naturalists' 'anecdotal' (to use an unhappily somewhat derogatory term of the Harperian school) field observations can be the basis for hypothesis, discussion and answers to the biologist's questions. The critical mind is ultimately the best analyst, as Harper clearly demonstrates; may he long continue to stimulate us in his retirement.

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The Oxford dictionary of natural history. Edited by M. Allaby. Pp. 688. Oxford University Press, Oxford. 1985. Price £20.00 (ISBN 0–19–217720–6).

This Dictionary was written by a team of 25 specialists in different aspects of natural history and contains over 12,000 entries. There are no illustrations. Unlike the *Penguin Dictionary of British Natural History*, one of the few other specialist dictionaries of the subject, this book attempts a worldwide coverage. The Preface explains the criteria which were applied in allocating space to the various aspects of the subject. On the whole the editor has achieved a very reasonable balance. However, botanists may detect a distinct zoological bias in entries such as "nomen conservandum" or "nomen nudum", where the *International Code of Zoological Nomenclature* is referred to without mention of its botanical counterpart. A further entry describes the ICZN but does not mention that there are other codes. This omission reflects the fact that whilst the Dictionary is excellent in its detail it is lacking in careful definitions of the generalities. This is unfortunate, because often it is broad concepts that exclude the amateur from the domain of the professional and preserve the barriers this Dictionary hopes to remove. There are no entries for "nomenclature", "systematics", "code", or "rank", and the single line entry on "taxonomy" is not cross-referenced to the entries which describe methods of classification. There are also inaccuracies resulting from omissions in the definitions of some fundamental terms. The fact that taxa above the species level have types is not apparent from the entry for "type specimen" and neither is it clear that "phenetic classification" can use data other than physical similarities or that a "synonym" is not simply a different name for a species or variety.

A large proportion of the Dictionary comprises entries relating to plant and animal taxa of various ranks, particularly families. The selection of taxa included is well balanced but could have been improved botanically by including the alternatives to such conserved family names as Compositae, Palmae or Gramineae especially since *Aster*, *Areca*, and *Poa* all have entries. Cross-referencing between the taxonomic entries is generally good but there are exceptions. The entry for "Palmae" could usefully have referred to that on "rattan" which itself does not mention palms but provides only a list of cross-referenced genera. The entries for two of these, *Plectocomia* and *Plectocomiopsis*, are missing whilst others (e.g. *Bejaudia*, *Calospatha*) provide more detail for these monotypic genera than is provided for some families.

Despite these criticisms the Dictionary will be useful as a source of information for those interested in ecology, conservation and in the biology of tropical organisms in particular. In hard back form it does not seem likely to match the volume of sales achieved by cheaper, soft back specialist dictionaries on other subjects.

S. Blackmore

No ordinary gardener, Thomas Knowlton, 1691–1781. B. Henrey, edited by A. O. Chater. Pp. 324, with 32 black & white illustrations. British Museum (Nat. Hist.), London. 1986. Price £17.50 (ISBN 0–565–00976–1).

A scholarly work, this is more than a well researched biography. Much valuable authoritative information is given concerning the gardener's employers, correspondents and other associates.

The introduction is a masterly and highly readable summary of Knowlton's career and various activities. Part 1 deals with the period 1691–1726, during which Thomas Knowlton's most important position was as head gardener to James Sherard at the time when the famous garden at Eltham, Kent was being established. Part 2 covers the rest of Knowlton's life, during which he was head gardener at the Londesborough estate in Yorkshire. It consists mainly of transcriptions from Knowlton's letters to eminent figures of the day, notably Hans Sloane and the botanists Samuel Brewer and Dr Richard Richardson, together with detailed commentaries on the topics mentioned. The abstracts selected not only illustrate Knowlton's wide interests, but also demonstrate how 18th century conditions affected his life.

Records for some 50 species of British native plants are included in the text; ten are in abstracts from the diary Knowlton kept during a visit to Guernsey in 1726 to study the Guernsey Lily, and the rest in letters written at Londesborough. Most of the latter records are for Yorkshire, but some are for Hertfordshire and Guernsey. Some records point to a very different past. Observations concerning the occurrence of *Stratiotes aloides* add to our knowledge of the distribution at that time of this now very rare S.E. Yorks. species. It occurred for instance in plenty between Hull and Beverley, in dykes on both sides of the road. *Primula farinosa* was found by the R. Wharfe at Otley, much further down the valley than it is now known. There are several records for Fountains Abbey, including *Cardamine impatiens*, *Paris quadrifolia*, *Primula farinosa* and *Cephalanthera damasonium*. The record for the last species: "*Hellesborine flore albo* ger wild att fountain abby" is puzzling as the locality is so far north of its otherwise recorded distribution.

Knowlton's use of pre-Linnaean nomenclature and his difficult handwriting presented a challenge to the authoress, as did his unconventional spelling. One error arose from the latter. Marsh Gentian was described as growing "plentifully in our Sawampis comons at Home & Everingham neare me in yorkeshie . . .". Home is Holme (upon Spalding Moor) with adjacent wet heathland and not Londesborough, Knowlton's home village on the chalk wolds, as suggested by Blanche Henrey.

Knowlton built up a living collection of uncommon wild plants, and there was clearly much exchanging of plants and seed of both native and imported species amongst gardeners and landowners. He had experience in growing exotic species at Eltham, and his skill in cultivating such species became widely recognized. He wrote a treatise on the cultivation of coffee trees which is reproduced. After a stove was erected at Londesborough he became increasingly interested in growing such plants and was notably successful in growing pineapples.

There are appendices giving information concerning Knowlton as tree planter and garden planner, bibliophile, subscriber to publications and as a man of property. There is also an abstract from his will and a classified list of plants mentioned in the book. I find the separate plant index of particular value. There are numerous references to source material in foot notes, but I would like to have seen a full bibliography.

The book is a good quality production. It is a fascinating social and historical document which, whilst of the strongest appeal to the garden historian, will I believe be enjoyed by a very wide readership.

It is sad that Blanche Henrey did not live to see the book published; the reader is indebted to A. O. Chater for ably carrying out the exacting task of preparing the final typescript.

F. E. Crackles

Rubi Westfalici. Die Brombeeren Westfalens und des Raumes Osnabrück (Rubus *L., subgenus* Rubus). H. E. Weber. Pp. 452, with 67 black & white photographs and 123 distribution maps. Westfälisches Museum für Naturkunde, Münster. 1985. Price DM 68.00 (ISBN 3–924590–07–9).

This is another major work by the leading European batologist of our day. It is carefully printed on firm glossy paper and strongly bound with a hard cover. There is a coloured illustration of ripe blackberries as large as life on the outside of the cover to sweeten the appetite. Westphalia is a province of western Germany bordering Holland and therefore near enough to the British Isles for a comparison of its flora with ours to be interesting. Indeed, of the 123 species of *Rubus* recorded for Westphalia one third are also found in the British Isles.

The book consists of a full explanatory and historical introduction, two keys to help in the identification of the species, detailed descriptions, maps and photographic illustrations. The distribution maps are excellent. There is one for every species; they are all the same size, large and very clear; black dots stand out sharply from a background which indicates the contours of the land. It is instructive to compare the different distributions of species which occur in both our countries. For example, *Rubus dasyphyllus* is limited to one comparatively small area in the north of Westphalia, though evidently common there, and *R. nemoralis*, though scattered throughout Westphalia, is rare. There are only twelve recent records. On the other hand *R. sprengelii* is abundant throughout the province, especially in the hillier areas.

Most of the illustrations are photographs of herbarium specimens and as good as such photos probably can be. They show the shape, dentition and disposition of the leaflets, but the stem clothing and armature and the floral characters are usually lost. The leaves of *R. mucronulatus* and *R. adspersus* are well illustrated. Sometimes close-up photographs of parts of the living plant are to be preferred. For example, the stem of *R. radula*, the rachis of *R. infestus* and the panicle of *R. sprengelii* are well illustrated in this way. It is always a big advantage to know the plant before you come to the photograph! Then the finer points of distinction become visible. Compare, for example, the illustrations of *R. nessensis* and *R. scissus*.

E. S. Edees

Unlucky plants. Compiled by R. Vickery. Pp. 92. The Folklore Society, London. 1985. Price £4.95 (ISBN 0–903515–10–5).

This short book is concerned with plants which are believed to bring misfortune if picked or taken indoors. Roy Vickery has compiled this collection from information supplied in a survey carried out by the Folklore Society. Their survey elicited 524 items, which related to 90 species of plant.

The result takes you right back to your childhood, triggering recollection of submerged beliefs – though in many cases they are not far below the surface. I know many people who today will not have lilac or may blossom in the house. There are several instances of transferred epithet, as for instance is the case with lilies and snowdrops and white flowers in general which, associated with funerals, have become the bringers of death. Sometimes it is the dangerous character of a place itself that seems to have attached itself to the reputation of the plants which grow there. Bog asphodel, called by Linnaeus *ossifragum* (bone-breaker) and dreaded by fell farmers because it 'softened sheep's bones', grows in acidic bogs, perilous for sheep. Similarly, it is possible that children are told that the seductive blooms of the yellow water lily bring ill luck, to protect them from the dangers of drowning in the waters where it grows. Mistletoe is not one of the plants under consideration, but I should like to know whether the reluctance to take mistletoe inside a church is anywhere explicit. For the most part, Mr Vickery steers clear of interpretation; but where he does make forays, they are always enlightening: the relationship between primroses and poultry-raising for instance. This interesting collection of folk belief seems like the tip of the iceberg. I hope it will provoke further study in this area, eliciting the *why* as well as the *what*.

F. Greenoak

Flora of the Isle of Man. D. E. Allen with the assistance of L. S. Garrad and M. Devereau. Pp. xi+250, with topographical map and six figures. The Manx Museum and National Trust, Douglas, Isle of Man. 1984. Price £13.75 (ISBN 0–901106–23–2).

This *Flora* is a traditional local Flora with no dot maps, and by current standards it is a modest volume. However, it is a book full of scholarship and reflects the author's study of the Isle of Man flora over 35 years.

The book is divided into six main chapters that consider the physical setting (nine pages), history and composition of the flora (eight pages), habitats (ten pages), the districts (two pages), discoverers of the flora (14 pages) and systematic list (178 pages). In addition, there are appendices on species and subspecies which might occur in Man and references to work on the lower plants, together with an extensive bibliography, acknowledgments and an index to plant names only.

In considering the introductory chapters the author gives competent and adequate accounts for the physical setting, and the history and composition of the flora. The chapter on the habitats of the Island gives the reader a good overall impression of what to expect on a visit to the Island, but I think more descriptive detail with lists of significant species for selected sites would have improved this section. The chapter on the discoverers of the flora is especially good. It takes the reader from the earliest recorders of the flora in the 16th Century through the problems and triumphs of the 19th and early 20th Centuries, to the present day in a most readable and informative manner.

The systematic list forms the main part of the *Flora* and avoids what, to the reviewer, is the annoying habit of only including recent records. This is a compilation of all records, and a distinction is made between pre- and post-1950 records; but it is not clear how thoroughly the Island's flora has been surveyed in recent years or to what extent the accounts are based on casual as opposed to systematic and quantifiable recording techniques.

Of interest to the reviewer is the citation of herbarium specimens. This is of immense value to future students and allows the present author's work, particularly in respect of critical groups, to be re-evaluated at some future date.

The records are organized according to six districts based on natural eco-geographical subdivisions, a scheme which in the context of the Isle of Man makes sense. Nevertheless, I would have liked to see a few selected dot maps which could have been used to advantage to show the distribution of certain species or change in status of others.

The author stresses the importance of assigning each species a status, and native, colonist, denizen or hortal categories are used. This is an area of considerable difficulty for botanists, but it is important to record change, to point out what is an introduction and to show how it might have arrived. It is the story behind the record that is of value, and in this David Allen has succeeded admirably.

The sequence and scientific names are those of Dandy's *List of British vascular plants* (1958) but recent changes have been incorporated. A feature of the *Flora* is the infraspecific detail that is provided, but unfortunately many of the names are not in Dandy nor in many of the more recently published standard Floras. Of particular note is the section on *Rubus*, which formed a special study.

Common names are included and usually follow *Pocket guide to wild flowers* (McClintock &

Fitter 1956). In addition, Manx names are given where these have been reliably identified with particular species.

There are six figures and a topographical map, which are adequate except for Figure 3, where the detail is lost. There are no reproductions of photographs and paintings except for the striking colour photograph of henbane on the dust jacket.

This is a Flora of succinct detail. It gives the results of considerable historical research into both people and their study of the flora, into the origins and uses of Isle of Man plants, and it gives much detail on the exact identity of the plants found in the Island. It is a worthy companion to other local Floras and indispensable for anyone interested in the Isle of Man flora.

E. F. Greenwood

A guide to the vegetation of Britain and Europe. O. Polunin & M. Walters. Pp. 238, with 60 plates of line drawings, 110 colour plates and 53 text figures. Oxford University Press, Oxford. 1985. Price £17.50 (ISBN 0–19–217713–3).

This is primarily a descriptive account aimed at the 'intelligent layman' of the vegetation of Europe (excluding Spitsbergen). It is a task for which the much-travelled authors, especially the late-lamented Oleg Polunin, were well-equipped. The main section of the book, Part II, which follows brief accounts of ecological concepts, soils, climates and vegetational history, deals with the subject mainly on a regional and climatic basis. Chapters 6–11, therefore, cover Arctic, Boreal, Atlantic, Central European, Mediterranean and Pannonic vegetation. However, these are followed by three dealing with Alpine, Fresh-water and Coastal plant communities. This approach, a mix of climatic and vegetational types, is the authors' compromise solution to the difficult problem of dealing with such a varied subject. In their view the vegetation of the last three is essentially azonal, occurring in more than one of the preceding climatic zones. The six preceding chapters cannot, therefore, be considered complete in themselves.

The problems of a regional approach are well illustrated by the treatment of mires. These receive their main discussion in the Boreal chapter, although arctic mires have already been mentioned, blanket bogs appear in the Atlantic one and raised bogs and fens in both this and the Central European and Alpine chapters.

The important maps in the Introduction are regrettably neither numbered nor provided with clear titles. The title is either hidden in the map with the key or, in one case, missing altogether. At the beginning of each of the first six chapters in Part II is a map showing the particular region in question, and these maps are based on the climatic zones shown in the map on p. 9. However, the picture is confused by the map of "potential vegetation" on p. 20, which is said on the following page to show the main regions. This shows the distribution of "poorly drained wetlands" (are these the fresh-water wetlands of chapter 13?), and a boreal area which, contrary to the climatic map and that in the Boreal chapter, includes, very sensibly, north-eastern Scotland and southern Sweden. There are further discrepancies in relation to the Mediterranean region, especially in the Balkans, and the Pannonic region isn't shown at all. These mistakes may be relatively minor but they are irritating and they do create a general impression of careless editing.

The longest chapter is, not surprisingly in view of the senior author's interests, that on Mediterranean vegetation. After a general introduction to the region and its climate, there are sections on evergreen oak woods, deciduous and semi-evergreen oakwoods, laurel woods, pine woods, montane coniferous woods, sweet chestnut woods, horse chestnut and walnut woods, fir woods, cypress and juniper woods, wet woods, bush communities and grasslands. Within each section there are maps of the dominant trees and many short lists of species to illustrate regional variants. For example, under evergreen oaks there are lists of *Quercus ilex* associates from southern Spain, Italy, the Adriatic coast of Yugoslavia and Greece, the briefer accounts of *Q. suber*, *Q. coccifera* and *Q. macrolepis* woods.

The communities are given English names which are not intended to conform to any particular classification, and the emphasis in the text is on English names, even for non-British species, such as the Bug (not Bog) Orchid, Star-fruited Fenugreek and Small-headed Blue-eryngo. The many lists inevitably result in a certain amount of repetition and their number does lead to a considerable loss in readability, with the result that this is inevitably more of a reference book.

As already mentioned the authors' aims are descriptive, but here and there are more informative sections dealing with the relationship between vegetational types, successional changes and the effects of man. This is especially true of the Mediterranean chapter. By contrast, the role of man and his animals in modifying montane vegetation and the tree-line is dismissed in a few lines. It is curious that the Alpine chapter makes no reference to altitudinal zonation within the alpine zone. There is confusion in the authors' use of the subalpine zone, which, in the glossary is said to be "usually above the tree-line" and to consist of "dwarf shrubs and stunted trees"; this is the lower alpine zone. The Arctic chapter is very unsatisfactory in that the map shows it as including the Scandinavian mountain chain and half of Iceland, but there is very little in it relating specifically to these areas and the only reference to Iceland in this Arctic chapter is to birchwoods! As a guide to Scandinavian or Icelandic montane vegetation this chapter is virtually useless. Why, incidentally, do the authors use the term 'arctic-alpine tundra' in preference to the more familiar 'fell-field'? Another irritating feature is the authors' failure to decide whether the Alpine chapter is Alpine or Arctic. Having included the Scandinavian mountains in the Arctic, we find the occasional reference in the Alpine chapter to northern examples such as Scottish tall herb communities and Scandinavian snow-patch communities "in the Boreal region"; it is all very confusing.

The decision to adopt a mainly regional approach means that the pinewoods of north-east Scotland are treated as Atlantic rather than boreal, and the chalk downlands of south-eastern England are similarly regarded as Atlantic, whereas their flora has a not unimportant central European and continental element. The authors' examples could sometimes be improved upon. There is no mention under Atlantic heaths of the very characteristic grass *Agrostis curtisii*, nor is there special mention in this chapter of *Digitalis purpurea*. Montane calcareous flushes in Scotland are said to be characterized by *Cratoneuron commutatum*, *Saxifraga aizoides*, *Festuca rubra* and *Cardamine pratensis*. This is true, but more widely distributed, much more interesting but unmentioned are the open flushes with many arctic-montane rarities, such as *Juncus alpinus*, *Kobresia simpliciuscula* and *Carex atrofusca*, in addition to *Juncus triglumis* and *Thalictrum alpinum*.

There is a third part to the book, a list of national parks and nature reserves arranged alphabetically by country. It is, in fact, an appendix, a useful one, but not an integral part of the text. The maps of the individual countries are poor, so reduced as to be well nigh illegible.

This is followed by a selected bibliography, a glossary and indices of Latin and English names of illustrated species and a final one to the plant communities, which is fine if you are attuned to the authors' terminology and are aware of dwarf fan-palm garigue and hedgehog heath alpine communities.

The book concludes with a fine set of colour plates which are both attractive and informative. I particularly like those of a palsa mire, of Atlantic oceanic heath (showing *Agrostis curtisii*, not *Deschampsia setacea*) and the Mediterranean woodlands. That of chalk grassland on the Sussex Downs is almost unrecognizable, and the penultimate plate is of *Crithmum maritimum*, not *Crambe maritima*.

Throughout the chapters are 57 pages of line drawings by Rosemary Wise. These are an excellent feature, clear and life-like, although generally rather faint. The diagrams and block diagrams of vegetation types are mostly unsatisfactory, being fuzzy and too stylized. The black & white plates are similarly rather poor, lacking in contrast and adding little to the text, for example those of *Ulex gallii* (Fig. 16), maquis (Fig. 35) and *Paliurus* (Fig. 36); the goats in Fig. 37 could be crossing a snow-patch rather than suffering the blistering heat of the Mediterranean hills.

Mis-spellings are very few; minor errors in the text include sub-tropical (p. 20) for sub-Mediterranean, "the grass *Kobresia myosuroides*", (p. 162), the occurrence of *Galium pumilum* in Iceland (p. 27) and the inadvertent inclusion (p. 69) of Atlantic acid grasslands within the calcareous ones. *Epipactis atrorubens* is *not* a characteristic species of machair (p. 190).

The main problem of this book is the sheer scale of the subject and the difficulty of organizing and condensing the material into a readable, comprehensible whole. Inevitably many communities get only the most cursory treatment – nine lines for sea-cliffs, for example. The task is virtually impossible in a book of this size. Parts I and II might occupy 191 pages but there are only 90 of actual text and half of these are taken up with lists.

Nevertheless this is a useful and informative book. The authors must be applauded for their willingness to undertake such a monumental task and for the impressive scale of their compilation, and the publishers for the attractiveness of the format and the reasonable price.

G. Halliday

Mountain flora of Greece, Volume 1. Edited by A. Strid. Pp. xxx+822, with 50 text figures. Cambridge University Press, Cambridge. 1986. Price £65.00 (ISBN 0–521–25737–9).

Some years ago my wife and I climbed to the Hellenic Alpine Club's Gamila hut in the northern Pindus. We were the first visitors of the year; the bedding was damp, the chimney blocked, so that we ended the night on the floor under a pall of smoke. But that is another story . . . The flowers around were plentiful, and I scrambled up the steep wall of Mount Timfi, near the hut, to its near-flat plateau with long views to Gamila, Smolikas, and the great gash of the Vikos gorge. Among the many good plants here was *Saxifraga oppositifolia.*

This seemed to me rather easterly of its Alpine range, so on return home I checked it in *Flora Europaea.* It was not recorded for Greece, so I felt I had a small plus. The first thing I did on opening *Mountain flora of Greece* was to look up *Saxifraga oppositifolia.* And there it was, a 1954 record of the late Dr Goulimis, that indefatigable Greek amateur botanist, confirmed by Professor Strid, from Timfi alone.

In fact, of some 926 taxa in the first volume of this notable work, about a third were either not recorded for Greece in *Flora Europaea*, or were there under different names or with different rank. 30 further taxa in *Flora Europaea* are omitted as erroneous or synonymous. This seems an astonishing proportion for a country relatively well explored by such great botanists as Heldreich, Grisebach, Orphanides and Rechinger among many others, with such as Dr Goulimis, Werner Greuter and Elli Stamatiadou in recent years.

The activities and publications of these botanists are cited and described in an Introduction which elaborates also the work of modern Swedish botanists and finally those of Arne Strid (Professor of Botany at the University of Copenhagen), Per Hartvig and their co-workers, who collected nearly 20,000 specimens which have been the main source for the descriptions in this volume. The criterion for inclusion, incidentally, is that of plants growing more or less exclusively above 1800 m.

The introduction ends with a brief but excellent outline of geography, topography and geology of the region, and a check-list of the mountain peaks according to district. These mountains include those of Crete and the highest Ionian and Aegean islands, even though some of these do not rise to 1800 m. In this section there is an account of the phytogeographical elements making up the Greek mountain flora, with their significant connections with the Alps and Carpathians and the mountain floras of Italy and Anatolia.

Fifty specially prepared line illustrations complete the volume, many of these showing several species or their diagnostic features, like the siliculae of *Alyssum* species, or the leaves and flower profiles of violas. There are nine for *Umbelliferae*!

Needless to say the keys, descriptions and locality citations are exemplary in this first volume, which encompasses vascular cryptogams, conifers, and angiosperms from *Fagaceae* to *Plumbaginaceae*, in its 800–plus pages. It is the first serious critical Greek flora since Hayek's *Prodromus Florae Peninsulae Balcanicae*, completed in 1933.

A. Huxley

Index of collectors in the Welsh National Herbarium. S. G. Harrison. Pp. 140. Amgueddfa Genedlaethol Cymru/National Museum of Wales, Cardiff. 1986. Price £12, or £13.10 by post from the National Museum of Wales, Cathays Park, Cardiff CF1 3NP. (ISBN 0-7200-0295-8).

The National Museum of Wales was founded nearly three-quarters of a century ago, and the formation of the Department of Botany herbarium began with the transfer in 1912 of 3500+ mounted plants from the Welsh Museum of Natural History, Arts and Antiquities (originally Cardiff

Museum and Art Gallery). Since those early days this embryonic collection has now increased to nearly 265,000 specimens gathered in many parts of the world by hundreds of collectors, although the more important herbaria are British with a strong bias to the Principality. The more valuable Welsh herbaria include those of the Rev. Hugh Davies (1739–1821), author of *Welsh Botanology* (1813), J. E. Griffith (1843–1933), compiler of *The flora of Anglesey & Carnarvon* (1895) and C. T. Vachell (1848–1914) & E. Vachell (1879–1948).

The *Index of Collectors in the Welsh National Herbarium* covers not only Spermatophyta and Pteridophyta, but also Bryophyta, Fungi, Lichens, Algae, Myxomycetes and Plant Galls. It lists alphabetically by surname the collectors whose dried plants are preserved at Cardiff, with details of forenames, years of birth (and where applicable, of death), in many cases data on the regions or areas whence the gatherings originated, and the years in which they were made. A selected bibliography is given, and appendices provide a selection of herbarium abbreviations, a numbered list of the British and Irish vice-counties, and some examples of collectors' handwriting. This is an excellent addition to the rapidly growing series of books cataloguing the plant collections at University and Museum Botany departments, which began in 1897 with the Druce & Vines account of the University of Oxford herbaria.

D. H. Kent

Habitat handbook no. 1. Hampstead Heath flora. J. Bellamy *et al.* Pp. 14+35 pp. of distribution maps, a list of extant and extinct species and two appendices, with 15 coloured photographs and 31 black & white figures. Department of Recreation and the Arts, Greater London Council. 1986. Price not stated (ISBN 7168–1653–9).

In this work the flowering plants are recorded on 100-metre squares, 25 of which form larger 500-metre squares, identifiable by means of a system of letters and numbers, and based on the National Grid. There is a general introduction, and two appendices contain lists of species in various habitats. There is evidence that the compilers consulted *London's Natural History* (Fitter) but none that they consulted recent Floras of Middlesex (Kent) or London (Burton). Nevertheless it is a painstaking piece of work most attractively presented, and it is to be hoped that it will be followed by subsequent editions in which not only will many additions to the existing maps be made, but the distribution of trees, shrubs, ferns, rushes, sedges and grasses be added. Nomenclature appears to be largely accurate though at least two errors have been noted.

K. G. Messenger

Flowers and ferns around Huddersfield. M. J. Lucas & J. Middleton. Pp. viii+115, with 23 pages of line drawings and two maps. Kirklees Leisure Services, Huddersfield. 1985. Price £2.95 (ISBN 0–9502568–8–9).

Since no previous attempt has been made to produce a complete list of flowering plants and ferns of the Huddersfield district, the authors of the present book are to be congratulated on their efforts to remedy this omission. It is somewhat surprising that in such a well-worked area such a list has not been produced before.

The authors acknowledge the help of past and present botanists in the use of their records, but one could wish that additional names had been mentioned, particularly those of the late Dr T. W. Woodhead of Tolson Memorial Museum, Huddersfield, the Rev. T. A. Jefferies and Dr J. Grainger, all of whom carried out work in the district, though mainly of an ecological nature.

The map of the area surveyed would perhaps have been of greater value had use been made of the tetrads, which could have been done without endangering species. The map of the river basins is of geographical interest.

Certain plant species not likely to be indigenous are said to be "native"; these, especially trees, include *Pinus sylvestris*, *Taxus baccata*, *Carpinus betulus*, *Sorbus aria* agg., *Clematis vitalba* and *Swida sanguinea*. Species such as *Medicago falcata*, *Foeniculum vulgare* and *Echium vulgare* can hardly be more than casuals in the area. Critical groups are generally dealt with in the widest sense, the brambles for example being all under *Rubus fruticosus* agg.

The Huddersfield canals have been intensively studied and are probably some of the best known botanically in the country. Along with many native species grow several of what the authors call "goldfish aliens", introduced aquatic species now well established, including *Egeria densa*, *Lagarosiphon major* and *Elodea nuttallii*. *Alisma lanceolatum* is stated "not to be recorded again as far as we know, till Angus/Kincardineshire". It does, however occur in both canal and river Calder not very far away. Is *Eleocharis acicularis* a rare plant?; it also grows in some quantity in the Calder.

The 23 pages of drawings by Derek Toms, though pleasing in themselves, seem to answer no useful purpose. The book is not intended to be a guide to identification, and in any case only a brief selection of species is illustrated. Possibly a few more detailed drawings of critical species would have been of more use; those of *Egeria*, *Elodea* and *Lagarosiphon* show some useful distinguishing features.

A few species present in the area are not included in the list. Perhaps at some later date a more complete and enlarged edition will be forthcoming.

F. Murgatroyd

Concise dictionary of biology. Edited by E. Martin. Pp. 256, with numerous line drawings. Oxford University Press, Oxford. 1985. Price £7.95 (ISBN 0–19–866144–4).

This dictionary is derived from the *Concise science dictionary* published by O.U.P. in 1984. It includes all the entries from that work relating to biology and biochemistry, together with those entries from geology necessary for an understanding of palaeontology, and a few entries relating to physics and chemistry which are required for an understanding of those aspects of biology. In addition there is a small selection of words used in medicine and palaeoanthropology.

The dictionary includes an extensive system of cross references, which means that each entry can be placed within a broader context: an initial enquiry may then lead to constructive browsing within its c. 3000 definitions.

In a field in which there are already many competitors this hardback may seem an attractive bargain. My only reservation is whether the blotting-paper on which it appears to have been printed will stand up to the frequent use for which worthwhile dictionaries must surely be prepared.

F. H. Perring

Guide to mountain and moorland. B. Brookes. Pp. 128, with numerous colour and monochrome photographs and line drawings. The British Naturalists' Association Guides. The Crowood Press, Marlborough, Wiltshire. 1985. Price £7.95 (ISBN 0–946284–76–8).

This little book, like its fellows in the series of guides to British habitats by the B.N.A., looks attractive, handles nicely, and is reasonably priced. Like the rest, the present volume seeks to attract by an abundance of illustrations – they occupy exactly half the book. Brian Brookes combines expertise in his subject with a clear and lively style. Six chapters cover Mountains, Moorlands, Moorland Wildlife, Mires, Forests, and Conservation. (Why was so much space devoted to "Forests"? The accounts of the development of moor from forest and the re-instatement of forest on moor are interesting, but surely description of the wildlife of those forests is beyond the scope of this book, especially when a companion volume covers "Woodlands".)

Predictably, in only sixty pages of script, the author has had to cover some topics in a somewhat superficial fashion, and the strength of the book lies in the success with which he has compressed so much into a small compass. In fact, for my money I would have preferred more Brookes and less pictures. Whilst some plates are excellent and evocative, others are too small, too 'muddy', or nothing to do with the subject. (A monochrome otter has a rather lame caption ". . . which sometimes inhabits upland sites . . ."!). Featured flowering plants include many common species, but botanists will be attracted by a tiny flowering Tufted Saxifrage (*Saxifraga cespitosa*) and frustrated by a single straggling stem, with bright pink flowers, of the Blue Sowthistle (*Cicerbita alpina*). Colour-balance is variable. Corrie Kander appears in perfect muted grey and brown; *Racomitrium lanuginosum* comes out a lurid green. In a book so dominated by illustrations, their lack of consistency is a major handicap.

The 'interested layman', and his (older) children, will, I think, enjoy the book, and the author's warnings on the fragility of upland ecosystems are both timely and appropriate: conservation will only be achieved when those who use the uplands have some empathy with the natural processes which create and sustain them.

F. J. Roberts

Infraspecific classification of wild and cultivated plants. Edited by B. T. Styles. Pp. xiv+435. Clarendon Press, Oxford. 1986. Price £47.50 (ISBN 0–19–857701–X).

The conference of which these are the published proceedings was held in September 1984 in Oxford by the Systematics Association in association with four organizations concerned with cultivated plants: the Royal Horticultural Society (RHS), the International Union of Forest Research Organizations (IUFRO), the International Board for Plant Genetic Resources (IBPGR) and the International Union for the Protection of New Varieties of Plants (UPON). It provided a forum for the exchange of information and viewpoints on plant variation at the infraspecific level.

Such a bridge-building exercise is greatly to be welcomed because, as Professor Hawkes and Professor Heywood agreed (in their introduction and summary, respectively), polarization of views between botanists and cultivators must be avoided. A considerable divergence of views is revealed as to how much the classifications used by the two groups of workers can or should connect, ranging from those of Lewis, who outlines a universal scheme of incorporating wild and cultivated plants and adding extra ranks (subspecioid, race, major group, cultivariant), to those of Turnbull and Griffins, who doubted whether foresters should use the *International Code of Nomenclature for Cultivated Plants* (ICNCP) at all.

Several speakers show that variation in some crop plants (e.g. *Brassica rapa, Solanum aethiopicum*) can be classified using cultivar groups; in others (e.g. annual *Bromus*, *Lens*, *Beta*) such groups can be treated as subspecies and integrated with the botanical classification, at the same time illuminating the variation induced by cultivation. In chile peppers, groundnuts and faba beans Barbara Pickersgill distinguishes three stages of such variation: (i) changes due to initial domestication, (ii) subsequent partition of variation in cultigens through geographical isolation, and (iii) ecological adaptation or human selection.

Continuous variation is another perennial taxonomic problem. Honor Prentice concludes that a single general-purpose classification cannot include information about complex infraspecific variation, and that supplementary maps and diagrams may be necessary to convey such information. On the other hand, Chris Brickell mentions the problem of the introduction to cultivation of plant from different parts of a continuously variable wild population. Such introductions often remain distinct in cultivation but not invariable; hence they cannot be classified as cultivars. In such cases he strongly favours the use of the botanical rank *forma*; I support him in this (cf. my treatment of *Hypericum olympicum* in *The Plantsman*, **2**: 193–200, 1980).

In reading this book, I was impressed by the efforts that are being made to bridge the wild/cultivated gap in plant taxonomy, despite the sometimes very different problems that have to be faced in each field of study. It is therefore to be recommended to *Watsonia* readers not only as an invaluable source book for taxonomic data, techniques and opinions, but also (and primarily in my view) as a demonstration that taxonomy within the garden wall, the field margin and the forest fence is very much alive and should not be ignored by the field botanist.

N. K. B. Robson

The flora and vegetation of Britain. Origin and changes – the facts and their interpretation. Edited by J. L. Harley & D. H. Lewis. Pp. 1–128, with numerous text-figures and two frontispieces. Academic Press, London. 1985. Price £5.00 (ISBN 0–12–325570–8).

This Festschrift celebrates the eightieth birthday of Professor Arthur Roy Clapham, being the proceedings of a symposium held at the University of Sheffield on 19th May 1984. The volume under review is actually a reprint of part of Volume 98 Part 1 of the *New Phytologist* (1984), of which Clapham was an editor for 30 years (1932–1961). To the original publication have been added in this volume a very brief index (not covering plant names), a frontispiece photograph of Professor Clapham (unfortunately undated but I believe c. 1970), and a photograph of the symposium participants (the two un-named faces are both B.S.B.I. members – no. 11 is Dr D. A. Ratcliffe and no. 16 is Mr T. C. G. Rich).

The main part of the volume consists of seven excellent review articles on ecology (2), vegetational history (3) and cytogenetic (1) and distributional (1) aspects of plant taxonomy. Coverage of mainstream taxonomy is singularly lacking but, as C. D. Pigott points out, Clapham was not primarily a taxonomist, so the bias towards ecology is fully justified.

Probably of greatest interest to B.S.B.I. members are the papers by S. M. Walters on the relation between the British and European floras, by T. T. Elkington on cytogenetic variation in the British flora, by C. D. Pigott on the ecology and conservation of the British flora, and by D. A. Ratcliffe on human influence on British vegetation since Medieval times. All of these, as well as the other three articles, make very interesting reading equally suitable for the bed and for the laboratory. My personal preferences are Ratcliffe's and Elkington's contributions, as these contain more 'meat' than some of the others and represent valuable assessments of important topics by leading active researchers. These two articles in particular are strongly recommended; I think no-one actively interested in the British flora will fail to gain new ideas or attitudes from their study.

C. A. STACE

Ölands och Gotlands Växtvärld en ekologisk och Kulturhistorisk Flora. U. Ekstam & R. Jacobson. Pp. 336, with 232 colour photographs, 15 maps and 6 text figures. Bokforlaget Natur och Kultur, Stockholm. 1984. Price 195 S.Kr. (ISBN 91–27–01319–7).

Gotland and Öland are two low-lying botanically interesting large limestone Swedish islands in the Baltic between 56°N and 58°N. Öland lies close to mainland Sweden, with which it is now connected by the longest bridge in Europe, but Gotland is more isolated. On account of their geology and maritime climate, together they possess a flora distinct from that of mainland Sweden, which is granitic, by sheltering a number of species unknown on the mainland, notably *Globularia vulgaris*, *Helianthemum oelandicum*, *Adonis vernalis* and various orchids. The two islands have floristically much in common, with approximately the same number of species on each, but some occur on the one which are not found on the other or are more abundant on the one than on the other. Their botanical exploration began in 1741, when Linnaeus visited them both with a party of five young gentlemen who came at their own expense, as his assistants in making and recording observations. He published in 1745 a detailed interesting account of their travels, *Olandska och Gothlandska Resa*, of which an annotated English translation by Åsberg and Stearn has been published in *Biological Journal of the Linnean Society*, **5**: 1–220 (1973).

Linnaeus wrote in his account for 1st June 1741 that "As soon as we touched the shore of Öland we realized this was a land which was altogether different from the rest of the Swedish provinces. Thus we decided to record everything we would see on this island more meticulously". Gotland they surveyed with the same eager curiosity and diligence, and not only as regards natural history. Linnaeus even noted that the speech of the Gotlanders "was somewhat different from ordinary Swedish and was somewhat like Norwegian in accent"; its phonology, according to Gudmund Schütte's erudite linguistic work, *Our Forefathers* (1933), gives it "a claim to be regarded as a separate branch co-ordinate with Swedish and Danish". In keeping with this evidence of isolation, *Pulsatilla vulgaris* subsp. *gotlandica* from the mainland is an endemic pasque-flower.

Linnaeus found on the two islands a number of species which he had not seen wild elsewhere, and he based his diagnoses in the *Species Plantarum* on Gotland or Öland material by references back to his *Ölandska och Gothlandska Resa*. Thus Gotland is the restricted type-locality for *Artemisia rupestris*, *Cladium mariscus*, *Geranium lucidum*, *Lactuca quercina*, *Melica ciliata*, *Pyrola minor*, *Schoenus nigricans*, *Scutellaria hastifolia* and *Tofieldia calyculata*. Öland is the restricted type-locality for *Atriplex hastata*, *Carex arenaria*, *Globularia vulgaris*, *Helianthemum oelandicum*, *Hornungia petraea*, *Oxytropis campestris* and *Tetragonolobus maritimus*. In view of this Linnaean association, but above all for the intrinsic interest of their plants, the two islands have received much attention both floristically and ecologically from Swedish botanists, culminating for Öland in Sterner's *Flora der Insel Öland* (1938). The literature relating to them is very extensive. *Öland och Gotlands Växtvärld*, profusely illustrated in colour from photographs by Marrus Mattson and Tord Porsne as well as by the two authors, is a welcome and innovative addition which can be thoroughly recommended as a guide to the plant world of these unique islands.

The work is not however, a conventional flora with all the species in one taxonomic sequence family by family. Instead they are grouped according to habitats, as the title partly implies. The first part deals primarily with general ecology, including human influence, for the islands have been inhabited for a long period. Here the different vegetation types are described and illustrated. Then follow concise accounts of the individual species, all illustrated with habit photographs, with notes on habitat, distribution and characteristic features. The little squares accompanying these neatly summarize occurrence: Ö (=Öland), G (=Gotland), S (=sällsynt; rare, uncommon), M (=måttlig; moderately common), a (allmän; common) as explained on p. 10, according to the number of places where found. The species are placed under 19 well defined habitats, which should be a convenience in fieldwork. Since this book would be invaluable for non-Swedish visitors to these islands now so accessible, the publishers might do well to issue with it a leaflet translating the page-headings, e.g. Äng och betesmark=meadow and pastureland; Vägkant=roadsides; Träsk och vattendrag=marsh and watercourses, etc. Visitors from the British Isles will find here many plants with which they are familiar, e.g. *Potentilla fruticosa* in Öland growing on limestone where water stands during the winter, as it does in the west of Ireland. More exciting are such specialities as *Globularia vulgaris* and *Helianthemum oelandicum*, relicts of a warmer period with their nearest representatives in southern Europe. Twenty-nine species of Orchidaceae, including *Dactylorhiza sambucina* with red and yellow forms often growing together and known as 'Adam och Eva', occur on the islands; although often abundant, they are rightly protected by law, as are *Adonis vernalis*, *Anemone sylvestris*, *Hepatica nobilis*, *Pulsatilla vulgaris*, *P. patens* and some other species. There appears to be no reference to Stora Karlsö and Lilla Karlsö off Gotland, the Charles Islands, where Linnaeus discovered *Artemisia rupestris* and *Lactuca quercina*. For anyone wishing to repeat Linnaeus's travels or simply to have a pleasant botanical holiday on Öland or Gotland, this book will be an excellent companion, the wealth of illustrations compensating for any linguistic difficulty.

W. T. STEARN

Cladistic biogeography. C. J. Humphries & L. R. Parenti. Oxford Monographs on Biogeography, No. 2. Pp. xii+98, with 67 text figures. Clarendon Press, Oxford. 1986. Price £19.50 (ISBN 0–19–854576–2).

Undoubtedly, Hennigian cladistics are an important tool of the modern systematist; likewise, cladistic biogeography, with its biological area-cladograms, is a useful approach to answering certain questions, particularly at the world scale, which is only one of many levels at which the biogeographer works. However, the strident and bombastic efforts of protagonists in these fields to make this approach the only acceptable one in biogeography are a nonsense and I, for one, refuse to be bounced into a paradigm shift. I find the methods inductive, mechanical, unrelated to process, retrospective (and thus dubiously 'historical'), lacking in any true sense of geography beyond that of latitude and longitude, and jargon-ridden in the extreme. Nevertheless, this brief book is an important contribution to biogeography, not the least because one can actually understand it, dense though the discussion is, and also because we are not treated to the same *ad hominem* abuse and rhetoric which has so far characterized much of the writing on the topic. It is, in my opinion, precisely the type of controversial contribution which should grace the *Oxford Monographs on Biogeography*.

Of course, the argument remains largely unchanged and, as normal, progresses through contrived opposites (dispersalist/vicariance biogeography – I give allegiance to neither), through assertion (e.g. "geological hypotheses do not test biogeographical patterns") and through the divorce of form or pattern from process (i.e. plants and animals don't actually need to live anywhere, but express their areas on isomorphic surfaces). The book presents a potted history of spatial biogeography, which naturally reaches the right cladistic conclusions, gives an excellent survey of methods employed by cladistic biogeographers, and then gets slightly obsessive about a lost 'Pacifica'. Particularly annoying is the in-built assumption that the convergence of pattern has eluded past biogeographers. What has certainly eluded the cladistic biogeographers is cartography; the maps are, quite frankly, appalling, being usually non-equal-area and lacking even scales. The authors also believe that the hypotheses of cladistic biogeography are 'testable' in the *true* scientific sense. They are, of course, testable only if you enter the philosophical circle of cladistic thought and then all is well, although when converted you must be especially careful not to fall into the trap of telling a 'story' or you will be roundly chastized, as is the fate of poor Rosen on p. 30.

Nevertheless, this volume is the best introduction so far to the 'vicariance approach' in biogeography, although at c. 20 pence per printed page members of the Society might not find the tough reading worth either the effort or the cost.

P. Stott

Supplement to the Flora of Gloucestershire. S. C. Holland, H. M. Caddick & D. S. Dudley-Smith. Pp. xx+196, including 8 colour plates and 20 black & white drawings. Grenfell Publications, Bristol. 1986. Price £11.50 (ISBN 0–948715–00–6).

The facsimile reprint in 1974 of *The flora of Gloucestershire* by H. J. Riddelsdell, G. W. Hedley and W. R. Price, published in 1948, helped to stimulate interest in the rich flora of the county and made increasingly clear the desirability of an account of the changes in plant distribution and status over nearly four decades. During that time, as elsewhere, construction of roads, abandonment of railways, quarrying, adoption of modern agricultural practices and especially drainage have affected the vegetation of many habitats and resulted in the loss of nearly one hundred species, a loss matched almost equally by gains in the flora. Since 1950, extensive fieldwork, the more recent based on a 2×2 km grid, has been undertaken by the Gloucestershire Naturalists' Society. In this *Supplement* Mrs Holland has acted as an energetic Executive Editor, with a Committee of Miss Caddick and Mrs Dudley-Smith and also, up to 1982, Miss K. E. Ludbrook.

Regrettably, except for *Rubus* and Charophytes, the *Supplement* does not cover the same area as the 1948 *Flora* but relates to the Administrative County of Gloucestershire established in 1974. The decision to restrict the recording to the new county boundary means a lack of comparability with the 1948 *Flora* as only part of Botanical District 5 is now covered, most of this falling in Avon. In terms of Watsonian vice-counties, this means that a floristically-rich part of v.c. 34 is excluded.

Most of the book constitutes detailed records complementing the entries of the earlier *Flora*, especially as regards occurrences in previously under-recorded areas. Perhaps inevitably the *Supplement* has to be read in conjunction with the 1948 *Flora* to obtain a picture of the overall distribution of a species in the county. For *Anacamptis pyramidalis*, for example, only two districts are mentioned in the *Supplement* and the reader may wonder to what extent this orchid occurs elsewhere. Some information given would have desirably been further updated; the colony of *Monotropa hypopitys* on Cleeve Hill is reported as about three hundred plants in 1964, but there is no information of its performance since.

Of particular interest are the details of changes in abundance and about species of restricted occurrence outside Gloucestershire. Distribution maps are given for some 16 taxa, including *Herminium monorchis* of diminished distribution and *Spiranthes spiralis* of increased abundance. The value of B.S.B.I. initiatives in surveys of particular species is reflected here in the maps and entries for *Populus nigra* and *Sorbus torminalis* among others. The contrast in distribution of *Gagea lutea*, *Saxifraga granulata* and *Thesium humifusum* is evident from the 'dot' maps. Although only a few maps are given, numbers of grid squares are routinely included for new localities, so that future mapping by computer can be undertaken.

A very attractive feature of this book is the high quality colour plates. Particularly notable among them are *Cuscuta europaea* on nettle (a survey of hosts is included but one queries whether haustorial contact was made with a 'host' such as *Prunus spinosa*) and a prolifically flowering colony of *Utricularia vulgaris*. Some of the black & white drawings usefully show taxa restricted to and of particular note in Gloucestershire and for which illustrations are not readily available. Among these are *Corrigiola telephiifolia*, new to the British alien flora but now feared lost, and a form of *Stellaria nemorum* intermediate between subsp. *nemorum* and subsp. *glochidisperma*. Some of the other plants, e.g. *Anagallis tenella*, are illustrated much better in well-known sources.

Attempts have commendably been made to explain changes in distribution, but the reasons advanced for these do not always seem probable. The decline of *Parnassia palustris* at Brassey Nature Reserve, which is linked with a large increase of *Juncus subnodulosus*, appears more likely to be associated with eutrophication than with climatic change as suggested. *Pinguicula vulgaris*, reported as "not seen in the 1970s and may have been lost" at Puckham Marsh was known to be at this site in 1975 (Dr B. D. Wheeler, pers. comm.).

Many records refer to aliens, and a list of well over a hundred casuals new to Gloucestershire is usefully included. Care has been taken over nomenclature but one wonders about the value of giving an English name such as "A Dodder" for *Cuscuta campestris*!

Despite some defects, this *Supplement* has much to commend it. The standard of production is high, typographical errors are few and there is much here for the plant lover and those interested in changes in plant distribution.

A. J. WILLIS

Obituaries

RONALD ARCHIE BONIFACE
(1913—1985)

Ron Boniface, a B.S.B.I. member since 1950, died in West Middlesex Hospital on Christmas Eve, 1985, from a brain tumour. Ron was born on 9th July 1913, in Eastbourne, Sussex, where he lived with his parents until World War II. In the thirties, besides being a keen racing cyclist, he became interested in plants as a hobby, and soon became an expert on the flora of the Eastbourne area. He contributed a number of interesting records to Wolley-Dod's (1937) *Flora of Sussex*. After a period on war work in Staffordshire, where he rediscovered the interest of Chartley Moss, he and his parents moved to Chiswick in West London, where he worked in building and as a motor engineer. He spent his spare time botanizing, his main interest lying in re-discovering plants that other botanists had given up as lost, and in exploring areas that were currently unknown botanically. He refound *Pinguicula vulgaris* for Hampshire in this way.

I first met Ron in 1947, and became most impressed with his keenness and remarkably critical knowledge of the British flora. Without formal training, he became in my opinion one of our most knowledgeable field botanists. About this time, Ron became interested in bryophytes too, and did excellent work on them in south-eastern England: he published a paper on the "Hepatics of the London Area" in the *London Naturalist* in 1956.

His contributions to botanical knowledge, however, were not to be measured by the few papers he actually published. His excellent herbarium has gone to the National Museum of Wales.

For many years, often accompanied by Ted Wallace, he was my regular companion on field trips. We had many long excursions to such places as the Scottish Highlands, Teesdale, East Anglia and other places. He was a good field companion, modest and even-tempered, and had a quiet, gentle sense of humour. When the weather was bad or the going strenuous a cup or two of really strong tea would always revive him, preferably the sort in which the spoon would almost stand up on its own!

Ron married Iris Bagshaw in 1959, and they had one daughter, Janet. I am indebted to his step-daughter, Mrs Carol Watson, for some information on his earlier life.

Those of us who knew him miss his gentle field companionship and his extraordinary knowledge of British plants and their habitats.

F. Rose

RONALD MELVILLE
(1903—1985)

Ronald Melville, I.S.O., B.Sc., Ph.D., M.P.S., Ph.C., F.L.S. died at the age of 82 on 6th August, 1985. Though an occasion for sadness, his death marked the end of a long, happy and fulfilling life, a distinguished career and a period of association with the Royal Botanic Gardens, Kew, spanning 50 years.

Ronald Melville was born in Bristol on 12th March 1903, the second of seven children, and first son of Edgar and Florence Melville. Only six months after his birth, the family moved to Cardiff and it was there that he spent his childhood. He originally intended to follow a career in medicine but, as his father died when he was 13, he left school after matriculation in 1919 to train in his uncle's pharmacy in Cardiff. In 1924 he became a member of the Pharmaceutical Society and, at the age of 22, he gained the Society's highest diploma, a qualification which now ranks as a degree. While practising pharmacy in retail shops and at the London Hospital, Whitechapel, he studied for an honours degree in Botany at Birkbeck College and graduated in 1931. In 1930 he became a research assistant under Professor V. H. Blackman of Imperial College, and gained a scholarship to study for a Ph.D. at the Research Institute at Cheshunt. During this time he was lecturing in the evening at Birkbeck College and also engaged in research on aquatic Phycomycetes under Dame Helen Gwynne-Vaughan and Dr B. Barnes. He was awarded his doctorate in 1934 for a thesis on the growth relationships of seedling tomato plants and joined the staff at Kew in November that year.

At the Royal Botanic Gardens he worked in the Museums with William Dallimore and then John Hutchinson, with whom he was later to collaborate in writing a book, *The story of plants and their uses to Man*, published in 1948. During his years in the Museums he became responsible for the identification of woody plants in the Arboretum at Kew and the conifers in the National Pinetum at Bedgebury. In 1936 he made an intensive study of the British elms and became an acknowledged authority. Problems in the elm complex and in intergrading *Ulmus* hybrids led, in turn, to studies in leaf morphology and ontogeny and the interaction between leaf-shape patterns in hybrids.

Through the 1939–1945 War he represented the Royal Botanic Gardens on several committees including the Vegetable Drugs Committee of the Ministry of Health. In this capacity, when the country's supply of vitamin C from citrus fruits was threatened, he recommended the use of rose hips as an alternative. With Dr Magnus Pyke working on their chemical assay, he then undertook a detailed survey of the British wild roses and examined the problems of classification in this group of pseudosexual unbalanced polyploids. Having first proposed the use of rose hips in the preparation of the now familiar vitamin-C-rich syrup, he became deeply involved in directing the development of its production and served on the Scientific Committee of the Rose Hip Products Association. His was indeed an extremely important contribution to the dietary welfare of the Nation.

After 16 years in the Museums at Kew he transferred to the Herbarium in 1950 to take charge of the Australasian Section, a responsibility he retained until his retirement. His expertise was greatly stimulated by a year spent in Australia from 1952 and 1953, when he was based in Melbourne Botanic Garden under the auspices of the Maud Gibson Trust and collected more than 20,000 specimens from many parts of that Continent, especially Victoria. Later, in 1961, he spent six months in New Zealand as a D.S.I.R. Senior Research Fellow at the Herbarium of the Botany Division, Lincoln, near Christchurch. While in Fiji on the return journey in 1962, he and his wife collected a rare *Glochidion* (Euphorbiaceae) which Kenneth Airy-Shaw in 1971 named *G. melvilliorum*; and, in 1978, an Australian *Acacia* was named *A. melvillei* by Dr Pedley of the Queensland Herbarium.

As a taxonomist, Ronald Melville sustained his early interest in hardy trees and shrubs, continuing his specialization in *Ulmus* and *Rosa* and becoming the B.S.B.I. Referee for both genera. He will be remembered with gratitude by the many members to whom he explained and demonstrated the intricacies of rose and elm classification on the field meetings that he led; and until shortly before his death he was always ready to name rose or elm specimens for members, no matter how large the parcel.

From 1956 he was engaged in researching floral evolution. A study of floral vascular systems by clearing techniques, begun in 1959, led to the formulation of the Gonophyll Theory to explain the nature of the flower and its evolution, and in developing his ideas he took into account the reproductive structures in extinct plants. Considering the reproductive organs of late Palaeozoic Glossopteridales (sensu lato), he came to regard the alleged bisexual structure of *Glossopteris* as occupying an important, key position in his theories, and believed that the occurrence of primitive structures in many extant Angiosperms supported the various intermediate evolutionary stages of both the male and female organs that he postulated in his 'New theory of the angiosperm flower'. Running parallel with his work on floral evolution, he studied the evidence for continental drift, which led him to a reconstruction of the Mesozoic Gondwana continent and an explanation for the migration routes of early Angiosperms from the southern to the northern hemisphere. Some of his preliminary studies of the phylogeny of several genera and the impact of continental drift on the distribution of species were discussed at the Gondwana symposium in Montevideo in 1967.

He retired as a Senior Principal Scientific Officer in March 1968, with more than 100 published papers to his credit. Nevertheless, he continued to be actively involved as a botanist, writing many more papers and working regularly at Kew until he suffered from declining health in 1985.

As a consequence of his work as a member of the Survival Service Commission for the International Union for Conservation of Nature and Natural Resources, he was responsible after retirement for compiling the first ever Red Data Book of threatened plant species, published in 1970, and he continued working for the I.U.C.N. until 1973. During his retirement, among his many other botanical interests, he turned his attention to studies of leaf venation, which, by 1970, had led to the discovery of Angiosperms with leaves closely resembling members of the fossil *Glossopteridae*. He related leaf, petal and sepal venation patterns to this fossil group and eventually formulated his Remoration Theory of evolutionary retrogression. Linking his findings with his theories on phytogeography and palaeomigration of plants, especially in the Pacific, and correlating evidence provided by floral anatomy, ontogeny, leaf structure and continental drift, he never ceased in his attempt to find a comprehensive solution to the problems of Angiosperm origin and evolution.

In 1935, he had married Elsie Sharpington, herself a botany graduate of Westfield College, University of London. They had two children, Fenella and John, and four grand-children and enjoyed a happy and tranquil family life. Later, his daughter also became a botanist and, in 1969, they together published a paper on fenestration in the leaves of *Monstera*.

From 1936 he served on various pharmaceutical committees and assisted in the production of a new edition of the *British Pharmacopoeia* (1949).

As a result of his work and interest in British trees and shrubs he had become a member of the Royal English Forestry Society in 1935, and from 1939 had served on committees of the Systematics Association, becoming its Botanical Secretary in 1946. In that year he was also elected to the Council of the Botanical Exchange Club (soon to become the Botanical Society of the British Isles), and in later years he was a member of the Richmond (Surrey) Scientific Society, serving as its President from 1975 to 1977 and continuing afterwards as a very active committee member. He was elected a fellow of the Linnean Society in 1938, and became a member of its Council from 1942 to 1946. In the New Year's Honours List of 1968, the year of his retirement, Dr Melville was made a Companion of the Imperial Service Order in recognition of his considerable and various contributions to science, including his key role in rose hip syrup development and his work on pollen analysis of honey.

Ronald Melville's important war-time proposal to use rose hips as a source of vitamin C, and his subsequent involvement in the development of rose hip syrup production will never be forgotten, but perhaps he will be best remembered among botanists for his theories of angiosperm evolution. There is no doubt that, borne of a very active and enquiring mind, his controversial theories and ideas on this and other topics have always stimulated discussion, and will continue to be subjects for keen debate. He was exceptional in his depth of knowledge in a wide field of botanical disciplines, and all who knew him during his many years at Kew will remember him with great affection.

M. J. S. Sands
N. K. B. Robson

ALEXANDER STUART WATT
(1892—1985)

Alexander Stuart Watt, F.R.S., Ph.D. was born near Turriff in Aberdeenshire on 21st June 1892 and died at Cambridge on 2nd March 1985 at the age of 92. Of farming stock, he graduated from the University of Aberdeen in 1913 and came to the Botany School at Cambridge to work under the pioneer ecologist Sir Arthur Tansley. After two years military service he returned briefly to Cambridge, but did most of the work for his Ph.D., which he obtained in 1924, while he was a lecturer at Aberdeen. In 1929 he was appointed Gurney Lecturer in Forestry at Cambridge, but when that department finished in 1933 he returned to the Botany School, where he was a lecturer until his retirement in 1959. He was President of the British Ecological Society in 1947, was elected to a Fellowship of the Royal Society in 1957 and received the Gold Medal of the Linnean Society in 1975.

Watt's profound knowledge of vegetation was based on meticulously recorded observations and experiments made in the field. His first work on the regeneration of oakwoods was followed by studies of the beech-woods of southern England and the heaths of the Cairngorms. But his greatest love was his study, continued long after retirement, of the grasslands and heaths of the East Anglian Breckland, on some of which he made continuous recordings for over 50 years. His knowledge of Bracken, *Pteridium aquilinum*, was encyclopedic, but the work that is probably most interesting to B.S.B.I. members was his research on the rare species characteristic of Breckland. He was sceptical of the Society and its activities pre-war, but joined in 1952, because he understood "they were now going to do some proper botany". He gave me a lesson in this when he made me dig a great hole in almost solid chalk so that he could demonstrate the massive tuberous stock of *Bryonia cretica* subsp. *dioica*. He quite rightly said that that would ensure I would not forget the fact.

Alec (or, as he was known to his contemporaries at Cambridge, 'Sandy') Watt was a truly modest and kindly man, but a wise councillor to all who asked his opinion. With his wife Annie he kept open house to many generations of students who remembered them with great affection.

P. D. Sell

MARY McCALLUM WEBSTER
(1906—1985)

Scottish botany lost an outstanding enthusiast when Mary McCallum Webster died on 7th November 1985 at the age of 78. She was born in Sussex on 31st December 1906 of Scottish parents. Her father, who was in the Army, was the son by her first marriage of Mrs M. L. Wedgwood, a friend of George Claridge Druce. She was educated at home until the age of 15 by a record number of governesses, 19 in 7 years. Finally, she achieved her ambition to go to boarding school – "to play games and wear a gym tunic", first at West Heath and then Ham Common. After her schooling she went to Brussels to 'finish'. She had always been interested in flowers, and botany was her best subject at school. Although she did various domestic jobs, played a lot of tennis and qualified for Wimbledon, and also played hockey for the district, she still found time to botanize a great deal. When war came, Mary joined the A.T.S. and was attached to the 10th Batt. Gordon Highlanders. She was sent to train at the first school of cookery at Aldershot from which she was posted to Orkney and later Shetland, where she was cook-sergeant at the time of the Battle of Narvik. The next move was to the Bournemouth Officers' Cadet Training Unit. She ended up as a Staff Captain in Field Marshall Montgomery's H.Q. in Germany in a branch disbanding the German Army.

After the war, she worked partly in hotels and partly free lance. While employed by friends in a hotel in Kinlochbervie, a party came to stay which included Humphrey Jennings and the famous ornithologist the late James Fisher. Stephen Potter pretended to be the botanist of the group. He used to spread out the daily finds under the kitchen table while she was busy concocting something special for dinner, and there would be a cry "Cookie, what is this?". And down she would get on all fours, naming the plants. From then on she decided that work was for the winter, and the summers were to be spent botanizing. When the B.S.B.I. mapping scheme was in progress for the *Atlas of the British flora*, having no car, she walked a 100 miles a week for several summers, recording the species in 266 grid squares in the north of Scotland.

In 1958 she visited her brother in Natal and then went on to a seven-month safari in Northern Rhodesia and Tanganyika, where she collected 5000 specimens for Kew. One of them is the holotype of a new species, *Digitaria melanotricha* W. D. Clayton, collected on Nsange Mountain, Ufipa, and another from Lake Chila, Abercorn District, the holotype of *Eragrostis mariae* Launert. The next three winters were spent at Kew helping to identify her African collections and doing some general curating. This was followed by four winters in the Cambridge herbarium. After a short time she decided that the technicians there were not working quite hard enough; with a mixture of firmness and cajolery she dragooned them into a formidable force, and the usually sedate herbarium was transformed into a hive of activity. It was in the happy days when extra labour was obtained by the University at an hourly rate, and she would often be found already at work at 8.30 a.m. and could still be found there at 10 p.m. When Mary came to fill in the cards for the *Hieracium* maps for the *Critical Atlas*, Cyril West came to sort out the specimens and advise on particular records. Both started early, both went without lunch and neither stopped very early for supper. The productivity was frightening.

The first of the various societies she joined was the Wild Flower Society in 1915. She was a faithful member all her life, and became the Secretary for the Scottish branch in 1968. So many beginners can thank her for her botanical help. She did not suffer fools gladly, but if one was willing to learn, Mary couldn't be more patient or instructive. Many 'Woofs' know their grasses from her saying: "*Holcus mollis* with hairy knees or *Poa nemoralis* with black knees". Her comments to those who ought to know better were very forthright. When P.D.S. altered the description of *Ranunculus ficaria* subsp. *bulbifer* in her Flora from larger flowers to smaller flowers, she left it. But when later he found that she indeed had large-flowered plants with bulbils in her area and confessed, he got the most tremendous ticking off. She joined the Botanical Society of Edinburgh in 1954, the Inverness Botany group in 1966 and was a member of the Moray Field Club. She was a Fellow of the Linnean Society from 1960 to 1974.

She became a member of the B.S.B.I. in 1936, serving on the Council from 1960–1964 and the Meetings Committee from 1960–1976. She was County Recorder for vice-counties 94 (Banff), 95 (Elgin) and a portion of 96 (Easterness). On a committee her remarks were very often very much to the point, and her frequent presence on field meetings usually meant that some very obscure plants would be recorded in the area for the first time.

Her first publication was a contribution with Peter Marler to the Flora of West Sutherland. In 1975 she produced a *Check list of the flora of the Culbin State Forest*, a place dear to her heart, where she took so many people to see *Goodyera*, *Corallorhiza*, *Orthilia* and her favourite *Moneses uniflora*.

Her most outstanding contribution to Scottish botany, however, was her *Flora of Moray, Nairn and East Inverness*, published in 1978. Mary was highly individualistic and this is clearly shown in her *Flora*. Using her life savings and helped by the financial support of two friends, she produced in her own words "a Flora how I want it done". It differs from all other county Floras in listing specimens and where they are to be found for nearly all the taxa. It contains a great many notes, keys and helpful drawings about critical taxa provided by her many friends, and the twenty plates of coloured photographs add a nice finishing touch. The maps with their dot distributions, which form such a dreary part of most modern county Floras, were banished to the end of the book. Although a dedicated 'square-basher' Mary was well aware that most botanists wanted to know where a plant grew, and a dot in a 10 km square did not help much. In size the book was also different from many of its large two- or even three-column contemporaries, fits easily into the hand and is graced with a delightful dust jacket. Her faith in the lay-out of the book was justified for, as she said, "It sold like hot cakes". The first 800 copies paid for all her expenses, and with the remaining money she was able to make two visits to Australia. The copyright of the *Flora* and the remaining 70–80 copies have been left to the B.S.B.I.

Latterly she was working on a check-list for Banffshire, and in 1983 led a large field meeting based on Tomintoul where over 15 N.C.R.s were recorded and 300 pink cards made out. That was the last of the many successful meetings she led for both the B.S.B.I. and the W.F.S. to Arran, Skye, Cairngorm and many other Scottish localities. She instilled into those who went into the field with her that the best way to help conservation was to mind where one put one's feet.

A visit to her cottage at Dyke made one aware of her varied interests: the pile of driftwood at the gate collected for flower arrangement, her garden full of unusual flowers where even the weeds were rich and rare, the porch full of recording cards and papers, dried flowers hanging on any available hook for her dried flower arrangements, and her press with specimens for the herbarium or her pressed flower pictures. All these she did with success, winning prizes for her flower arrangements and firsts for her dried flower pictures exhibited at the Royal Highland Show.

The only time Botany took second place was during Wimbledon fortnight when she was glued to the television, or during the tennis tournaments in north-east Scotland, particularly at Nairn and Elgin, where she competed until three years ago. A tennis cup in her cottage is a reminder of how good a tennis player she was. She was given it to keep after she won the Ladies' Open Singles at the North of Scotland tournament four years running during the 1950s.

Having seen virtually every wild plant growing naturally in the British Isles, she became greatly interested in shoddy plants, and she loved the excitement of finding an unknown species on the shingle at Galashiels or in the shoddy-manured fields in the south. She found the knowledge gained from looking at these aliens was a help in identifying the grasses she saw on her two trips to Western Australia. These two trips made a sort of grand finale to a life in which the love of flowers played such an important part and to which the glory of the Australian flora brought such great pleasure in her last years.

Her British specimens are divided between the Department of Botany, University of Aberdeen (**ABD**), the Botany School, University of Cambridge (**CGE**) and the Royal Botanic Garden, Edinburgh (**E**). Cambridge is particularly rich in critical taxa of a wide range of genera, especially

Hieracium or "hawkers" as she called them. Many of her colour slides are also preserved in the Cambridge herbarium.

Mary McCallum Webster was a remarkable person, who at both work and play never gave less than a hundred per cent, nor would she tolerate slackness in others. Her forthright views often brought disagreements, but her many friends will best remember her for her robust good humour and lasting loyalty. Her life was dedicated to her love of the Scottish flora and is best expressed by the words of S. M. Walters in his foreword to her *Flora* "One whose heart was always, and remains, 'in the Highlands'. There are really few better places for one to be."

O. M. Stewart
P. D. Sell

CYRIL WEST
(1887—1986)

Cyril West, O.B.E., M.A., D.Sc., F.L.S. was born at Forest Hill, near Sydenham, Kent on 16th December 1887 and died in hospital at Linton near Maidstone, Kent on 25th March 1986 at the age of 98. His father, John Stapylton West, was a tea dealer in the City who also lived to a great age, of 96. Cyril West's school education was at St Olave's in London, after which he went to the Imperial College of Science from 1907–1914 and 1916–1919. He took honours in Botany and received his B.Sc. in 1911 and his D.Sc. in 1918.

Soon after the outbreak of the First World War he was commissioned in the Royal Artillery; but an accident with a horse seriously injured his knee, and after a long stay in hospital a medical board recommended his transfer to the Special Reserve of Officers, whereupon he returned to the Imperial College. In old age the damage to his knee brought about trouble with his ankle, which finally prevented him walking into the mountains after hawkweeds.

At Imperial College, West began research under V. H. Blackman on the dormancy of seeds, then moved to Cambridge to continue it with Franklin Kidd, both of them working under Blackman's more distinguished brother, F. F. Blackman. At St John's College they became associated with George Briggs (1893–1985), and the three of them collaborated in studies of plant growth which resulted in two famous papers in *Annals of Applied Biology* in 1920, discussed by G. C. Evans in chapter 13 of his *The Quantitative Analysis of Plant Growth* (1972). The work on seed dormancy led to their study of the effects of carbon dioxide on plant metabolism, and thus to the controlled atmosphere storage of fruit, first in the laboratory, then in tests at Chivers' farm at Histon; and their results finally came into commercial use in 1928. This project led to the establishment of a Food Investigation Organization with a main laboratory in Cambridge known as the Low Temperature Research Station. Kidd and West joined its staff; but soon afterwards money became available to investigate the transport of fruit from abroad and a laboratory was built at Ditton, near Maidstone in Kent. West was Superintendent of this laboratory from 1931 until 1949, when he returned to Cambridge and remained there until his retirement in 1951. Throughout this period Kidd and West published a long series of joint papers, and in 1963 they were presented with Kamerlingh Onnes Medals at Leiden for their work on cold storage. A full report on this was published in *Mededelingen van de Nederlandse Vereniging voor Koeltechniek* in 1963. This is the only time, as far as I am aware, that West went outside the British Isles.

While working at Cambridge between 1919 and 1922 West demonstrated to students in the Botany School, and Sir Harry Godwin in his autobiography *Cambridge and Clare* (1985) says how impressed he was by West's conviction of the supreme value to biological students of examining fresh material at every opportunity. He took his B.A. in 1921 and his M.A. in 1926.

Cyril West's interest in the British flora was quite different from his interest in plant physiology. It gave him intense pleasure to look at a plant just for its beauty; he would make long journeys to see a plant for the first time, and much of his spare time was spent looking at them. His love of plants is perhaps best illustrated by an incident on what was his last visit to a mountain locality. Archie Kenneth had managed to get him up the chair-lift at Allt nan Guibhas in Glen Coe. On returning from a short walk Archie found Cyril sitting on a rock stroking the hairs of *Hieracium holosericeum*, one of the most beautiful of all hawkweeds.

In his very long life he had travelled the length and breadth of the British Isles and he probably saw more British species of plants living than any other botanist has ever done. I do not think he had any ordinary species left to see; he had seen nearly all the species of *Hieracium*, W. C. R. Watson had shown him over 300 of the *Rubi* he recognized, and I had checked off most of the *Fumariae*, *Sorbi* and *Euphrasiae* and some of the *Taraxaca* for him. Towards the end of his life he was shown many aliens, and I told him about many varieties. As a young man he was very fond of rock climbing in North Wales, which enabled him to see such plants as *Lloydia* at close range. He only collected plants other than *Hieracium* which he thought might be useful to the Cambridge herbarium or if I especially asked him to get something.

Cyril West's great contribution to systematic botany was his work on the genus *Hieracium*. It was a group he had always been interested in and which he had discussed with F. J. Hanbury and H. W. Pugsley. Only when he was about to retire and Pugsley's *Prodromus* had just been published did he begin the study of the genus seriously. In 1950 I had just returned from National Service and was considering what critical genus to take up. I finally decided on *Hieracium* and was examining the specimens in the Cambridge herbarium when in walked Cyril West with the same object in mind. We joined forces, little knowing that our partnership was to last for over thirty years.

In the early days when he was regularly in Cambridge working at the Low Temperature Station we spent an enormous amount of time putting the Cambridge specimens in order and getting to know the species recognized by Pugsley. Later, throughout the winter, when he was mostly in Kent he would come up for four days a month. It was then I discovered his remarkable staying power. Our days were usually from 9 a.m. to 9 p.m., but it was I who was drooping at the end of the day and completely exhausted after four days, but he, even when at the age of 90, went off to catch his train as though nothing had happened. And he never had anything to eat between breakfast and supper and then not very much. When not at Cambridge he would spend much of his time in the room he still had in the Ditton Laboratory 35 years after he had retired, poring over his specimens, or visiting the British Museum (Nat. Hist.) to work out a whole series of problems to be discussed on his next visit to Cambridge. As I had other official work to do, much of the donkey work was left to him. Many local flora writers and recorders owe it to him for passing on to them information we had worked out. Much of the most meticulous proof reading was also carried out by him. The 52 pages of *Hieracium* in *Flora Europaea* were letter by letter, figure by figure, twice checked back to the original manuscript over a period of two very long days. This gave him a severe headache, but when I offered him medication he would only take half an aspirin. Although his main interest was the British species of *Hieracium* he readily gave up the time to write the more important accounts for *Flora Europaea* and *Flora of Turkey*.

During the summer months he spent much time searching for hawkweeds in the field. In the 1950s his companion was Major J. W. Cardew, who rode a Sunbeam twin, West sitting in the sidecar with all the equipment. When necessary the sidecar was taken off and they went up remote mountain tracks on the motor bike. In later years he regularly visited Archie Kenneth in Kintyre. Archie would go into the mountains to collect and he would examine and press the specimens, a task which often took half the night. In the early days he was loth to collect specimens at all because of his strong feelings about conservation, but he eventually realized it was necessary and his later gatherings are all first class. His grid references must be considered with care. He would never take a map into the field and often put vague localities on his specimens. When I pressed him to include references he did so, but only afterwards from memory. Those specimens collected by Archie Kenneth usually have very precise grid references. His work on *Hieracia* in relation to other work on the genus and lists of published papers is set out in a paper I have written, now awaiting publication in *Watsonia*.

He originally joined the old Botanical Society and Exchange Club in 1914, resigned in protest at the way in which Druce collected such a large number of specimens, and joined again after Druce's death. He was made an Honorary Member in 1973. He was elected a Fellow of the Linnean Society in 1913 and an Honorary Fellow in 1978. He was a very prominent conservationist, joining the Kent Naturalists' Trust in 1961 and sitting on its council from 9 March 1961. He was a founder member of the Kent Field Club, of which he was made President when over the age of 90.

West always wore a dark grey suit, stiff white collar, grey tie, white silk scarf, lightweight black boots, and a black trilby hat. You were just as likely to meet him so dressed in the middle of the Cairngorms as in the centre of London. If it was wet he might tuck his trousers in his socks and put on a mackintosh and sou'wester. If he got wet through he would still appear for dinner dressed exactly the same, though changed. He referred to his good suits and his bad suits, but they all looked exactly the same to me.

He had a great love of cricket and was privileged to see the two great innings by Frank Woolley against the Australians at Lords in 1921. I could not resist mentioning it occasionally, for the memory of it never failed to bring tears of joy to his eyes. Woolley played for his beloved Kent, and in his eyes neither Don Bradman or Jack Hobbs could touch him for elegance and grace.

Cyril West was one of the kindest men I ever met. The technicians in the Cambridge herbarium would do anything for him. They packed his parcels, supplied him with all his needs and brought him his tea. And in return they all got boxes of chocolates for Christmas. We celebrated his 90th birthday in the Cambridge herbarium with a great iced cake which was one of the few items of food of which he was very fond. I only once heard him speak of a botanist with any ill-will and that was George Claridge Druce. When I suggested we named one of the new Shetland hawkweeds after him he flatly refused, saying that compared with E. S. Marshall and H. W. Pugsley he was very second rate and his F.R.S. was a scandal.

He will be much missed by his many friends.

P. D. Sell

Report

ANNUAL GENERAL MEETING, 10TH MAY 1986

The Annual General Meeting of the Society was held in the rooms of the Linnean Society of London, at 12 noon, with 83 members present. Mr D. E. Allen M.A., F.L.S., President, took the chair.

Apologies for absence were read, and the Minutes of the last Annual General Meeting, as published in *Watsonia*, **16**: 109–110 (1986), were approved unanimously and signed by the President.

REPORT OF COUNCIL

The Report for the calendar year 1985 was accepted nem. con., and some highlights for the Society during the year were reviewed: a record attendance at the Annual Exhibition Meeting in London; a successful conference on *Critical Groups* in the flora of the British Isles held at the Merseyside County Museums; and the setting up of the Conservation Association of Botanical Societies. It was noted that the B.S.B.I. Conservation Committee would be retained. Plans for a new mapping survey, proposed for 1987, had progressed well during the year.

TREASURER'S REPORT AND ACCOUNTS

The Report was accepted nem. con. Comment on the steady but slow increase in membership was discussed, and the possibility of a more vigorous recruitment policy suggested to increase income for ambitious publications. Experience had shown however that many of the new members joining in large numbers following publicity stayed with the Society for about one year only. The general feeling was not to change the Society to attract more members.

ELECTION OF OFFICERS

From the chair, Mr Allen proposed the re-election of Mrs M. Briggs M.B.E., F.P.S., F.L.S., as Honorary Secretary General and Mr M. Walpole F.L.A., F.L.S., as Honorary Treasurer, and these were carried with applause. Mr Allen, thanking all the Society's Officers, took the opportunity to acknowledge the Secretaries of the Permanent Working Committees as the workhorses behind the scenes, upon whom the Society depended for the success of its varied activities. Mrs J. Robertson, retiring Honorary Meetings Secretary, was warmly thanked for her contribution to the Society's programmes, and Mrs A. Lee was welcomed as her successor, with reference to her help in past years, in particular her contribution to the 1985 Annual Exhibition Meeting. Sincere thanks to the Editors of the Society's publications were coupled with a particular note of acknowledgment to Mr E. D. Wiggins, retiring Editor of *B.S.B.I. News*, for his achievement in producing 27 numbers of this publication which, under his editorship, has become such a popular and valued feature of the life of the Society.

ELECTION OF COUNCIL MEMBERS

In accordance with Rule 10, nominations had been received for Lady R. FitzGerald, Dr P. A. Gay and Mrs S. Oldfield. Their election was proposed by Mr F. H. Brightman, seconded by Dr C. P. Petch, and carried unanimously.

ELECTION OF HONORARY MEMBERS

Council had nominated Professor D. H. Valentine and Mr E. D. Wiggins, and the President was delighted to propose their nomination from the chair. This was carried with warm applause.

RE-ELECTION OF HONORARY AUDITORS

The re-election of Grant-Thornton (formerly Thornton-Baker) as Honorary Auditors was proposed by Mr D. J. McCosh, seconded by Mr D. H. Kent, and carried unanimously with the Society's gratitude.

ANY OTHER BUSINESS

Mr Walpole, commenting on this significant occasion of the Society's Sesquicentenary, thanked the President for conducting the Proceedings of the day, and for his Presidential Address, which had given opportunity for the Society to take stock at the Sesquicentenary, and also for writing his excellent book *The Botanists – the history of the Botanical Society of the British Isles*. The Society was deeply grateful to him for all the hard work and research for this.

There being no further business, the meeting closed at 12.50.

M. Briggs

AFTERNOON SESSION

During the afternoon following the A.G.M., short discussion papers were presented by the Chairman and Secretary of each of the four Permanent Working Committees. 30 minutes was allotted to each committee, in which a summary was presented of current activities, followed by a discussion with comment and suggestions invited from the floor.

Dr N. K. B. Robson, Mrs A. Lee and R. Smith (Field Meetings Secretary) presented the activities of the Meetings Committee. They put forward the proposal of a symposium-type meeting, with papers, on the day following the Annual Exhibition Meeting. It was noted that field meetings had increased from 27 in 1982 to 35 in 1986, but the number was still possibly insufficient for the demand.

The Society's publications were reviewed by M. Walpole and A. O. Chater (Publications Committee), with emphasis on the journals, notably the contents of *Watsonia* vis-à-vis *B.S.B.I. News*. The possibility of publishing more on intraspecific variants and less on aliens in *B.S.B.I. News* was discussed.

For the Records Committee, D. E. Allen introduced D. A. Wells, who outlined plans for the new mapping scheme scheduled for 1987–88. There was discussion of this, and on the many demands on vice-county recorders – which should be monitored to prevent overloading recorders with work.

Mr Allen remained in the chair for the presentation of the work of the Conservation Committee, and Miss L. Farrell outlined the more important issues. A number of threatened species were under consideration for the Quinquennial Review of plants scheduled in the Wildlife and Countryside Act of 1981. Some useful information on these was provided by members present, and it was agreed that a note in *B.S.B.I. News* requesting specific information would help with the problem plants, as each member's knowledge could contribute and be of value.

CONVERSAZIONE

In the evening, after the formal business of the day had been completed, 55 members and guests attended a Conversazione in the Library at the Linnean Society's rooms. We were pleased to welcome representatives from the following Societies: the Linnean Society of London, British Bryological Society, British Lichen Society, British Mycological Society, British Pteridological

Society, Wild Flower Society, and the Royal Society for Nature Conservation. Mr Allen welcomed five other presidents and other representatives of these Societies, and thanked the Linnean Society for the use of their premises and Miss E. Young for her outstanding flower arrangements. The President of the Linnean Society, Professor W. G. Chaloner F.R.S., served the party with wine and light refreshments.

M. Briggs

EXCURSION HELD IN CONJUNCTION WITH ANNUAL GENERAL MEETING

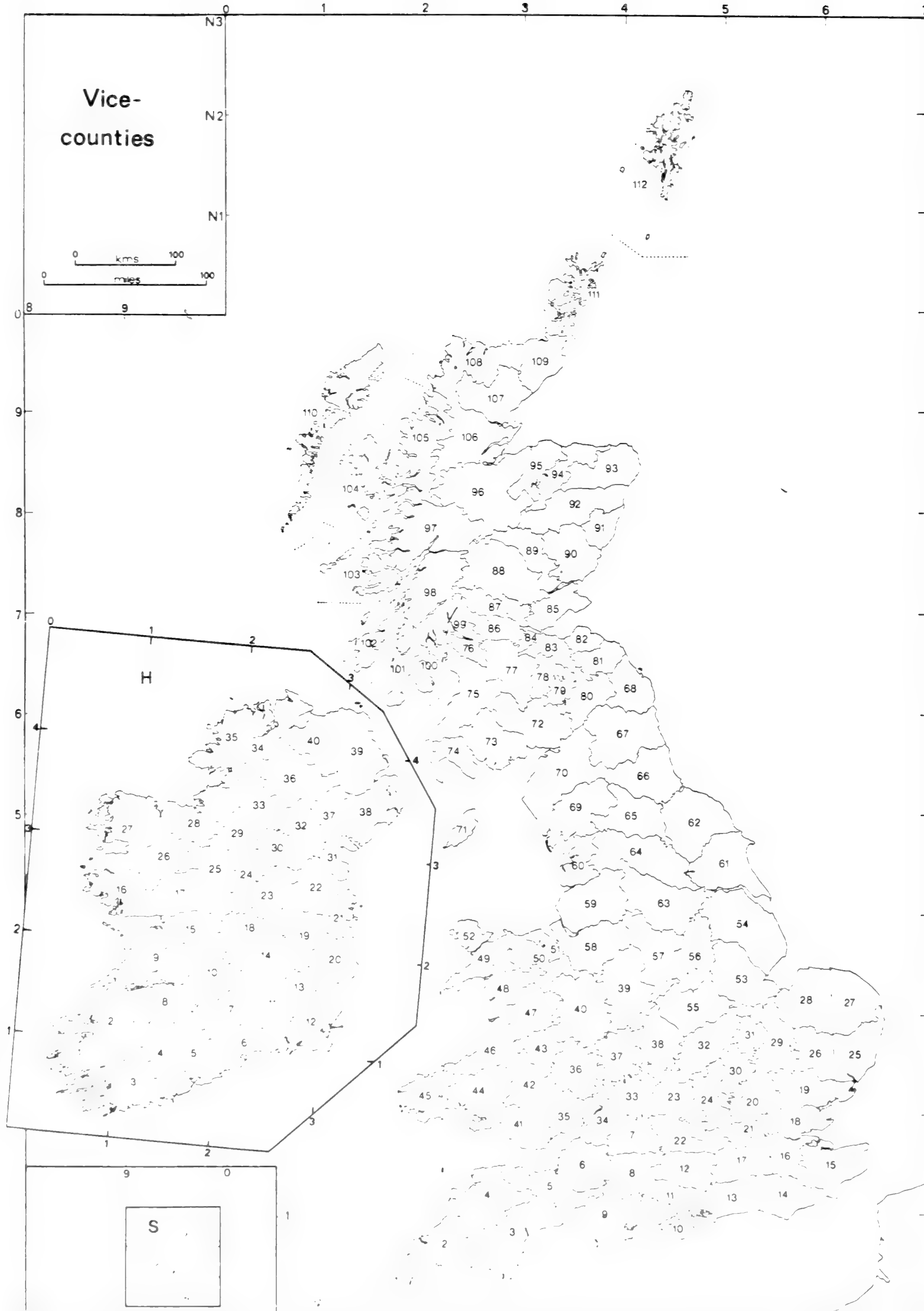
SHEFFIELD PARK AND BLUEBELL RAILWAY. 11TH MAY 1986

A small but enthusiastic party of some 40 B.S.B.I. members and guests gathered at 11.00 hrs at Sheffield Park, near Haywards Heath, in Sussex. The party was given a guided tour of the extensive woodland gardens, which support a varied 'wild' flora, notably good quantities of *Ophioglossum vulgatum*, which is being encouraged by the gardens' staff. The fine collection of trees and shrubs was admired, as were various aliens such as *Claytonia sibirica*, nicely in flower.

After a picnic lunch, the group assembled at the nearby terminus of the Bluebell Railway, thence embarking on the superb steam train. As the train made its leisurely progress across the green, spring countryside, we were able to enjoy a varied display of wayside and woodland flowers. The afternoon was a celebration of the most traditional aspects of our subject, with the show of spring flowers seen in the context of a lively 'charabanc' type of outing in good company and, for many of us, an excellent cream tea served in the traditional dining-car. At the other terminus there was an opportunity to stretch legs and to examine the weeds in the station flower-beds. Segregates of *Veronica hederifolia* provoked lively discussion. Alas, the Bluebells were late after a cold spring and were far from their best.

Several of the party had come in period costume, and at the end of the ride, back at Sheffield Park, the assorted clergymen, ladies and gentlemen, and a ruffian with a cudgel, posed for photographs. Chris Preston's clergyman role was a great success, but nearly led to his downfall a few minutes later when the car in which he was travelling stopped to ask the way from a real gentleman of the cloth! As usual, a small band of diehards set out afterwards to visit nearby botanical sites: they were rewarded by numerous tiny plants of *Montia fontana* subsp. *chondrosperma* on a damp corner of a village green, but in general the late season was against them. It was a most enjoyable day!

J. R. Akeroyd



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INSTRUCTIONS TO CONTRIBUTORS

Papers and Short Notes concerning the systematics and distribution of British and European vascular plants as well as topics of a more general character are invited.

Manuscripts must be submitted in duplicate, typewritten on one side of the paper only, with wide margins and double-spaced throughout. They should follow recent issues of *Watsonia* in all matters of format, including abstracts, headings, tables, keys, figures, references and appendices. Note particularly use of capitals and italics. *Only underline where italics are required.*

Tables, appendices and captions to figures should be typed on separate sheets and attached at the end of the manuscript. Names of periodicals in the references should be abbreviated as in the *World list of scientific periodicals*, and herbaria as in Kent & Allen's *British and Irish herbaria.* Line drawings should be in Indian ink on good quality white card, blue-lined graph paper or tracing paper. They should be drawn at least twice the final size and they will normally occupy the full width of the page. Lettering should be done in Letraset or by high-quality stencilling, though graph axes and other more extensive labelling are best done in pencil and left to the printer. Photographs can be accepted only in exceptional cases.

Contributors are strongly advised to consult the editors before submission in any cases of doubt. 25 offprints are given free to authors of papers and Short Notes. Further copies may be purchased in multiples of 25 at the current price. The Society takes no responsibility for the views expressed by authors of articles.

Papers and Short Notes should be sent to Dr R. J. Gornall, Botany Department, The University, Leicester, LE1 7RH. Books for review should be sent to Dr N. K. B. Robson, Botany Department, British Museum (Natural History), Cromwell Road, London, SW7 5BD. Plant records should be sent to the appropriate vice-county recorders. Reports of field meetings should be sent to Dr B. S. Rushton, Biology Department, The University of Ulster, Coleraine, Co. Londonderry, N. Ireland, BT52 1SA.

B.S.B.I. Publications

1. BRITISH FLOWERING PLANTS AND MODERN SYSTEMATIC METHODS
   Ed. A. J. Wilmott, 1948. 104 pages, 18 plates. Wrappers. £4.25
2. THE STUDY OF THE DISTRIBUTION OF BRITISH PLANTS
   Ed. J. E. Lousley, 1951. 128 pages, illustrations and maps. £4.25
4. SPECIES STUDIES IN THE BRITISH FLORA
   Ed. J. E. Lousley, 1955. 189 pages, 2 plates and 23 text figs. £5.25
5. PROGRESS IN THE STUDY OF THE BRITISH FLORA
   Ed. J. E. Lousley, 1957, 128 pages, 4 plates and 9 text figs. £5.25
8. THE CONSERVATION OF THE BRITISH FLORA
   Ed. E. Milne-Redhead, 1963. 90 pages. £5.25
11. FLORA OF A CHANGING BRITAIN (Reprint, 1973)
   Ed. F. H. Perring, 1970. 158 pages, 21 text figs. Paperback. £3.50
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